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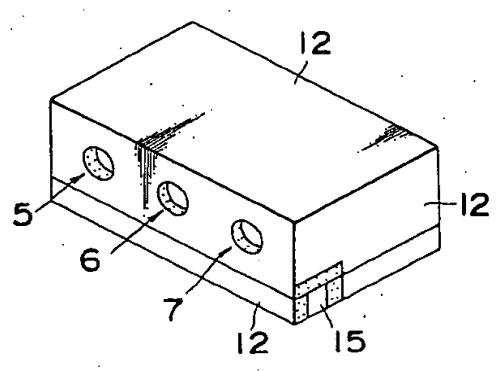
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Dielectric resonator and manufacturing method thereof.

Grooves are formed on the connection faces of the dielectric basic plates as a dielectric resonator, and also, an internal conductor is provided on the inside face, and coupling electrodes are formed on the other dielectric basic plate. These three dielectric basic plates are connected so that the coupling electrode effects capacity connection between internal conductors and the coupling electrode effects capacity connection between the internal conductors, whereby an earth electrode (external conductor) can be formed on almost full face on the reverse face side of the dielectric basic plate and the reduction of Qo of the resonator and the electromagnetic field leakage can be prevented.

Fig. 1



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BACKGROUND OF THE INVENTION

The present invention generally relates to a dielectric resonator with an earth electrode and a resonance electrode being formed on a dielectric basic plate or a dielectric block, and a manufacturing method thereof.

A dielectric resonator having resonance electrodes (internal conductors) formed within a dielectric block, earth electrodes (external conductors) formed on the outside face of a dielectric block, and a dielectric resonator having resonance electrodes (strip lines) formed on the surface of a dielectric basic plate and earth electrodes formed on their opposite faces are used as filters and so on in, for example, microwave bands.

Coils for connecting resonators, capacitors and basic plates and so on for mounting them, together with a plurality of dielectric resonators are accommodated within a case in a dielectric filter of a discrete type using, for example, a plurality of dielectric resonators.

Diversified dielectric resonators, coils and capacitors are used in accordance with the required specifications in the dielectric filters of such construction. In an integrated type of dielectric filter, a plurality of resonators are constructed on a dielectric block which is integral from the beginning, or to be integrated by the assembling operation, and are used as many stages of dielectric filters and so on.

A transmission filter and a reception filter are used in a transceiver sharing device in, for example, the microwave band. Characteristics which are smaller in the damping amount of the transmission band and sufficiently large in the damping amount of the reception band are required as the reception filters. It is effective to have a pole (hereinafter referred to as polarization) as an effective method in the designing of the band passing filter capable of the given damping amount in a zone generally away from the passing band width. In the dielectric filter of the conventional construction, it is not suitable for a dielectric filter of a type of mounting on the surface on, for example, the basic plate, because the terminal for coupling use has to be inserted from the outside into the resonance electrode formed hole so as to connect between the resonators of the given stages and the special parts for the operation is required in order to directly effect the electromagnetic connection among its front, rear resonators with the resonator of one stage or more being jumped over.

A dielectric resonator of such a surface mounting type shown in Fig. 65 and Fig. 66 is taken into consideration as the present application has applied in Japanese Patent Laid-Open Publication No. 3-303366.

Fig. 65 is a perspective view of a dielectric resonator. Fig. 66 is a top face view of a dielectric resonator. In Fig. 65, reference numerals 10, 103 are respectively dielectric basic plates. Sectional semi-circular shaped grooves 105, 106, 107, 108, 109 are provided respectively on a first main face (a face opposite to the dielectric basic plate 103) of the dielectric basic plate 102 and the first main face (a face opposite to the dielectric basic plate 102) of the dielectric basic plate 103, with internal conductors being respectively formed on the inside faces thereof. Signal input, output electrodes (115 and so on) are formed across the second main face (bottom face in the drawing) from two side faces of the dielectric basic plates 103. Coupling electrodes E110 are formed on the given region of the second main face (top face in the drawing) of the dielectric basic plate 102. An external conductor 112 is formed on the external surfaces of the dielectric basic plates 102, 103 except for the formed regions of the above described signal input, output electrodes (115 and so on) and the coupling electrode E10. As shown in Fig. 66, the coupling electrodes E10 effect the respective capacity connection with the open end vicinity of the internal conductors 117, 119 within the internal formed holes 106, 108. By such construction, the second stage and the fourth stage effect the capacity connection between them among the band passing filters of five stages so as to cause the damping pole in the low-pass of the passing band width.

The dielectric resonators shown in Fig. 65 and Fig. 66 can be polarized without addition of special parts, with a large operational effect that the surface mounting operation can be effected on the circuit basic plate together with the electronic parts of the other surface mounting type. In such conventional dielectric filter as shown in Fig. 65 and Fig. 66, the Q_0 value of the resonator is lower, thus resulting in danger in deteriorating the insertion loss characteristics as the filter, because the current of flowing through the external conductor 112 is interrupted in the forming region of the coupling electrode E10. As the coupling electrode formed region becomes an open portion of the external conductor, some electromagnetic field leakage is caused, influences by the metallic unit which becomes adjacent to the dielectric filter may become a problem.

In a dielectric filter of the conventional discrete type, individual parts such as coil, capacitor or the like are required together with a plurality of dielectric resonator, with a defect that the whole becomes larger in size with number of the parts being more, and the assembling operation step is complicated. In the conventional integral type of dielectric filter, only the filter of the characteristics restricted is provided in the pattern formation of the

resonance electrode or the earth electrode although the above described defects are not provided. When the plan circuit and so on are constructed with one portion of the earth electrode (external conductors) being patterned, some measures are required to be taken with respect to the electromagnetic leakage.

Also, in the conventional dielectric filter, there is danger of lowering the Q_0 value of the resonator, deteriorating the insertion loss characteristics as a filter, because the current flowing through the external conductor is interrupted in the formed region of the coupling electrode. As the coupling electrode formed region becomes an opening portion of the external conductor, there is danger of causing some electromagnetic leakage with a problem of influence by the metallic unit adjacent to the dielectric filter.

In the conventional dielectric filter, the respective parts of basic plate, capacitor element and coil are necessary and further, a soldering operation with the respective parts being engaged with is required, with problems that the cost rises and also, the productivity is lower.

Further, as a polarized electrode is formed within the region of the earth electrode with one portion of the earth electrode of the dielectric basic plate being shaved in the conventional polarized construction, the earth current flowing through the above described earth electrode is interrupted in the above described gap portion, with a problem that the Q_0 value of the resonance electrode is deteriorated, and the characteristics of the insertion loss is lowered.

SUMMARY OF THE INVENTION

Accordingly, a primary object of the present invention is to provide a dielectric resonator which basically assumes the construction of an integral type dielectric resonator and is smaller in size and can easily obtain the given characteristics.

Another object of the present invention is to provide a dielectric resonator which is capable of effecting polarization without addition of special parts;

Still object of the present invention is to provide a dielectric resonator which is suitable for polarized dielectric filter superior in the insertion loss characteristic without loss of Q_0 value of the resonator;

A further object of the present invention is to provide a dielectric filter which can reduce the number of parts to reduce the cost, and can improve the productivity with the manufacturing steps being omitted.

A still further object of the present invention is to provide a dielectric filter which can avoid the

deterioration of the Q_0 value, when the polarized electrode can be added, to improve the insertion loss.

A dielectric resonator of a first invention is composed of additional electrode layers within the above described dielectric in a dielectric resonator where a plurality of resonance electrodes are arranged, a dielectric is interposed between the the resonance electrodes and the each electrodes.

In the dielectric of the first invention, a plurality of resonance electrodes and earth electrodes are formed through dielectrics and also, additional electrode layers are provided within the dielectric. The additional electrode layers function as electrodes to be connected with, for example, the resonance electrodes, electrodes for constituting inductor, capacitor, line and so on or a plan circuit including them, and constitute various types of filters and so on such as BPF, BEF, LPF, HPF or the like together with a plurality of resonators.

A dielectric resonator in accordance with a second invention has a coupling electrode layer provided for effecting capacity connection with a plurality of resonance electrodes is provided within the above described dielectric, in a dielectric resonator where a plurality of resonance electrodes are arranged, dielectrics are interposed among these resonance electrodes and the earth electrodes.

In a dielectric resonator of a second invention, a plurality of resonance electrodes and earth electrodes are formed through dielectrics, and also, coupling electric layers are provided within the dielectric. The coupling electrode layer is connected in capacity with a plurality of resonance electrodes. In a band passing filter of, for example, three stages or more, a damping pole is formed on the high-pass side of the passing band by the capacity connection through a coupling electrode layer between a first, second stages of resonance electrodes. If the capacity connection is effected through the coupling electrode layer between the resonance electrodes of second and fourth stages of resonance electrodes in, for example, five stages of band passing filter, a damping pole is formed on the loss-pass side of the passing band.

The additional electrode layer is provided within the dielectric. The coupling electrode is not required to be provided within the earth electrode formed region. Current flowing through the earth electrodes is not interrupted. The Q_0 value is not lowered. The filter can be used as a dielectric filter of less insertion loss.

A third invention is a dielectric filter characterized in that an earth electrode is formed on the other main face of the dielectric basic plate, a plurality of resonance electrodes are formed on one main face, one side face of the resonance electrode is connected with the above described

earth electrode so as to have a coupling electrode, a stray electrode and a coil electrode pattern-formed within the above described dielectric basic plate.

In order to form the respective electrodes within the above described dielectric basic plate, the portion facing the resonance electrode of the dielectric basic plate is cut into two divisions, and the respective electrodes are formed in pattern by, for example, a screen printing method on one of the divided cut faces so as to stick both of them.

When the resonance electrode is formed on the above described dielectric basic plate, both are connected with each other if adjacent resonance electrodes are brought to get too closer, so that the desired characteristics may not be obtained. In order to avoid the connection of the resonance electrodes, a removing operation can be effected by the interval between the resonance electrodes. The size of the dielectric basic plate becomes larger correspondingly by the interval of both the electrodes, thus causing a disadvantage that the whole parts becomes larger in size.

According to the dielectric filter of the third invention, the coupling electrode, the stray electrode and the coil electrode are formed in pattern within the dielectric basic plate, and the respective electrodes can be formed at the same time. The number of the parts can be reduced as compared with a case where a basic plate is disposed on the conventional dielectric coaxial resonator, the parts such as capacitor element, coil and so on are connected with the basic plate, and the cost can be lowered, thus improving productivity.

A fourth invention is characterized in that the shielding electrode is formed between the adjacent resonance electrodes on one main face of the above described dielectric basic plate, and both the ends of the shielding electrode are connected with the above described earth electrodes.

In the fourth invention, the shielding electrode connected with the earth electrode is formed between the resonance electrodes of the above described dielectric basic plate. As the electric force lines to be emitted from both the above described resonance electrodes are absorbed by the shielding electrodes, the intervals between the resonance electrodes can be narrowed without deterioration in the characteristics, and the dielectric basic plate can be made correspondingly smaller in size.

A fifth invention is characterized in that the above described polarized electrode is formed within the above described dielectric basic plate, in the polarized construction of a dielectric filter where a plurality of resonance electrodes are formed on one main face of the dielectric basic plate, and an earth electrode is formed on the other main face, one side face of the above described

resonance electrode is connected with the earth electrode, a polarized electrode for connecting in capacity the above described resonance electrode with the above described dielectric basic plate is formed.

In order to form the polarized electrode within the above described dielectric basic plate, a portion facing the resonance electrode of the above described dielectric basic plate is cut so as to have the basic plate formed into two divisions, the polarized electrode is formed on the cut face of one side of the divided form so as to stick both of them.

According to the dielectric filter of the fifth invention, the polarized electrode is formed within the dielectric basic plate. As the earth electrode can be formed on the full face of the other main face of the dielectric basic plate, the obstacle of the electric current in the formation of the polarized electrode by the shaving the conventional earth electrode can be removed. As a result, the reduction in the insertion loss can be improved by the avoidance of the deterioration in the Q_0 value, thus improving the electric characteristics.

A method of manufacturing a dielectric resonator of a sixth invention comprises the steps of connecting a dielectric basic plate with a plurality of resonance electrode films being formed on it with a plurality of basic plates including a dielectric basic plate with an additional electrode films being formed on it, manufacturing a dielectric resonator having the additional electrode layers within the dielectric.

In a method of manufacturing the dielectric resonator of the sixth invention, the dielectric resonator having the additional electrode layers within the dielectric is manufactured by the connection of a dielectric basic plate with a plurality of resonance electrode films being formed on it with a plurality of basic plates including dielectric basic plate with additional electrode films being formed on it.

Therefore, the additional electrode layers to be provided within the dielectric has only to be formed in advance on the dielectric basic surface.

A method of manufacturing a dielectric resonator of a seventh invention comprises the steps of connecting a dielectric basic plate with a plurality of resonance electrode films and additional electrode films being formed on it opposite to the these resonance electrode films, with a plurality of basic plates including the other dielectric basic plate, manufacturing a dielectric resonator having additional electrode layers in the dielectric interior.

In a method of manufacturing the dielectric resonator of the seventh invention, a plurality of resonance electrode films and additional electrode films opposite to these resonance electrode films are formed on a certain one dielectric basic plate,

and the other basic plate is connected on the basic plate.

A method of manufacturing a dielectric resonator of an eighth invention comprises the steps of composing a dielectric unit having a plurality of resonance electrode films formed therein, connecting a dielectric basic plate with the additional electrode films being formed on it with the above described dielectric unit, manufacturing a dielectric resonator having additional electrode layers within the dielectric.

In a method of manufacturing the dielectric resonator of the eighth invention, the dielectric basic plate with additional electrode films being formed on it is connected with respect to the dielectric unit with a plurality of resonance electrode dielectric films being formed therein. In this case, the dielectric unit constitutes a plurality of dielectric resonators, and a plane circuit is added with respect to a plurality of dielectric resonators by the connection the dielectric basic plates having the additional electrode films.

A method of manufacturing a dielectric resonator of a ninth invention comprises the steps of using a dielectric ceramic green sheet with a plurality of resonance electrode films being formed on it, a dielectric ceramic green sheet with additional electrode films being formed on it, effecting an integral laminated burning operation, manufacturing a dielectric resonator having additional electrode layers within the dielectric.

In the method of manufacturing the dielectric resonator of the ninth invention, the dielectric ceramic green sheet with a plurality of resonance electrode films being formed on it, the dielectric ceramic green sheet with additional electrode films being formed on it are burned integrally in lamination. Therefore, the additional electrode films are formed on the dielectric ceramic green sheet in this case, and the additional electrode layers are constructed within the dielectric by the subsequent integral burning operation.

A method of manufacturing a dielectric resonator of a tenth invention comprises the steps of connecting a dielectric basic plate with a plurality of resonance electrode films being formed on it with a plurality of basic plates including a dielectric basic plate with a coupling electrode film being formed on it, manufacturing a dielectric resonator having coupling electrode layers within the dielectric.

In a method of manufacturing a dielectric resonator of the tenth invention, a dielectric basic plate with a plurality of resonator electrode films being formed on it is connected with a plurality of basic plates including a dielectric basic plate with coupling electrode films being formed on it so that a dielectric resonator having coupling electrode lay-

ers within the dielectric is manufactured. Therefore, coupling electrode layers to be provided within the dielectric has only to be formed on the dielectric basic surface in advance.

A method of manufacturing a dielectric resonator of an eleventh invention comprises the steps of connecting a dielectric basic plate with a plurality of resonance electrode films and coupling electrode films being formed opposite to these resonance electrode films with a plurality of basic plates of the other dielectric basic plate, manufacturing a dielectric resonator having the coupling electrode layers within the dielectric.

In a method of manufacturing a dielectric resonator of the eleventh invention, a plurality of resonance electrode films and coupling electrode films opposite to these resonance electrode films are formed on a certain one dielectric basic plate, and the other basic plate is connected with the basic plate.

A method of manufacturing a dielectric resonator of a twelfth invention comprises the steps of constituting a dielectric unit with a plurality of resonance electrode films therein being formed therein, connecting a dielectric basic plate with coupling electrode films being formed on it with the above described dielectric unit, manufacturing a dielectric resonator having coupling electrode layers within the dielectric.

In a method of manufacturing the dielectric resonator of the twelfth invention, the dielectric basic plate with the coupling electrode films being formed on it is connected with respect to a dielectric unit with a plurality of resonance electrode films being formed therein. In this case, the dielectric unit constitutes a plurality of dielectric resonators, coupling electrodes are added with respect to the plurality of dielectric resonators by the connection of the dielectric basic plate having the coupling electrode films.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with the preferred embodiment thereof with reference to the accompanying drawings, in which;

Fig. 1 is a perspective view of a dielectric filter in accordance with a first embodiment;

Fig. 2 is an explosive perspective view before the assembling operation of a dielectric filter in accordance with the first embodiment;

Fig. 3 is a plan view of a dielectric basic plate to be used in the dielectric filter in accordance with the first embodiment;

Fig. 4 is an equivalent circuit diagram of the dielectric filter in accordance with the first em-

bodiment;

Fig. 5 is a perspective view of a dielectric filter in accordance with a second embodiment;

Fig. 6 is an explosive perspective view of the dielectric filter in accordance with the second embodiment;

Fig. 7 is a plan view of a dielectric basic plate using a dielectric filter in accordance with the second embodiment;

Fig. 8 is an equivalent circuit diagram of a dielectric filter in accordance with the second embodiment;

Fig. 9 is a plan view of a dielectric basic plate using a dielectric filter in accordance with a third embodiment;

Fig. 10 is a perspective view of a dielectric filter in accordance with a fourth embodiment;

Fig. 11 is an explosive perspective view of the dielectric filter in accordance with the fourth embodiment;

Fig. 12 is a perspective view of a dielectric filter in accordance with a fifth embodiment;

Fig. 13 is an explosive perspective view of the dielectric filter in accordance with the fifth embodiment;

Fig. 14 is a perspective view of a dielectric filter in accordance with a sixth embodiment;

Fig. 15 is an explosive perspective view of the dielectric filter in accordance with the sixth embodiment;

Fig. 16 is a perspective view of a dielectric filter in accordance with a seventh embodiment;

Fig. 17 is an explosive perspective view of the dielectric filter in accordance with the seventh embodiment;

Fig. 18 is an explosive perspective view of a dielectric filter in accordance with an eighth embodiment;

Fig. 19 is a sectional view of the dielectric filter in accordance with the eighth embodiment;

Fig. 20 is an equivalent circuit diagram of a dielectric filter in accordance with the eighth embodiment;

Fig. 21 is an explosive perspective view of a dielectric filter in accordance with a ninth embodiment;

Fig. 22 is a sectional view of the dielectric filter in accordance with the ninth embodiment;

Fig. 23 is a sectional view of a dielectric filter in accordance with a tenth embodiment;

Fig. 24 is an explosive perspective view of a dielectric filter in accordance with an eleventh embodiment;

Fig. 25 is an explosive perspective view of a dielectric filter in accordance with a twelfth embodiment;

Fig. 26 is an explaining view in accordance with the thirteenth embodiment, (A) being a sectional

view thereof; (B) is a front view thereof;

Fig. 27 is a front face view of a dielectric filter showing a dielectric filter characteristic adjusting method;

Fig. 28 is a front face view showing a conductor deleted example for the characteristic measurement of the dielectric filter;

Fig. 29 is a partial front face view showing the conductor deleted example for the characteristic measurement of the dielectric filter;

Fig. 30 is a view showing the measurement result of the coupling coefficient change in the dielectric filter;

Fig. 31 is a view showing the measurement result of the resonance frequency change in the dielectric filter;

Fig. 32 is a front face view of the dielectric filter;

Fig. 33 is an explosive perspective view for illustrating a polarized construction of a tri-plates type of dielectric filter in accordance with a fourteenth embodiment of the present invention;

Fig. 34 is a perspective view of a tri-plates type of dielectric filter in the fourth embodiment;

Fig. 35 is an explosive perspective view showing the polarized construction of a tri-plates type of dielectric filter in a fifteenth embodiment of the present invention;

Fig. 36 is an explosive perspective view showing the polarized construction of a sixteenth embodiment of the present invention;

Fig. 37 is an explosive perspective view showing the polarized construction of a strip line type of dielectric filter in accordance with a seventeenth embodiment of the present invention;

Fig. 38 is an explosive perspective view for illustrating a dielectric filter of a tri-plates construction in accordance with an eighteenth embodiment of the present invention;

Fig. 39 is a sectional side face view of a dielectric filter in the eighteenth embodiment;

Fig. 40 is an explosive perspective view showing a dielectric filter of the strip line construction in a nineteenth embodiment of the present invention;

Fig. 41 is an explosive perspective view for illustrating the dielectric filter of the tri-plates construction of a twentieth embodiment in accordance with the present invention;

Fig. 42 is a sectional front face view of a dielectric filter in the twentieth embodiment;

Fig. 43 is a sectional front face view showing a dielectric filter in a twenty first embodiment;

Fig. 44 is an equivalent circuit diagram of the general band elimination filter;

Fig. 45 is an explosive perspective view of a dielectric filter in accordance with a twenty second embodiment;

Fig. 46 is a perspective view of a dielectric filter in accordance with the twenty second embodiment;

Fig. 47 is an equivalent circuit diagram of a dielectric filter in accordance with the twenty second embodiment;

Fig. 48 is a characteristic view of a dielectric filter in accordance with the twenty second embodiment;

Fig. 49 is an explosive perspective view of a dielectric filter in accordance with a twenty third embodiment;

Fig. 50 is a perspective view of a dielectric filter in accordance with the twenty third embodiment;

Fig. 51 is an equivalent circuit diagram of a dielectric filter in accordance with the twenty third embodiment;

Fig. 52 is a characteristic view of a dielectric filter in accordance with the twenty third embodiment;

Fig. 53 is an explosive perspective view of a dielectric filter in accordance with a twenty fourth embodiment;

Fig. 54 is a perspective view of a dielectric filter in accordance with the twenty fourth embodiment;

Fig. 55 is an explosive perspective view of a dielectric filter in accordance with a twenty fifth embodiment;

Fig. 56 is a perspective view of a dielectric filter in accordance with the twenty fifth embodiment;

Fig. 57 is an explosive perspective view of a dielectric filter in accordance with a twenty sixth embodiment;

Fig. 58 is a perspective view of a dielectric filter in accordance with the twenty sixth embodiment;

Fig. 59 is an explosive perspective view of a dielectric filter in accordance with a twenty seventh embodiment;

Fig. 60 is a perspective view of a dielectric filter in accordance with the twenty seventh embodiment;

Fig. 61 is an explosive perspective view of a dielectric filter in accordance with a twenty eighth embodiment;

Fig. 62 is a perspective view of a dielectric filter in accordance with the twenty eighth;

Fig. 63 is an explosive view of a dielectric filter in accordance with a twenty ninth embodiment;

Fig. 64 is an explosive perspective view of a dielectric filter in accordance with a thirtieth embodiment;

Fig. 65 is a perspective view of the conventional dielectric resonator; and

Fig. 66 is a top face view of a dielectric resonator shown in Fig. 65.

DETAILED DESCRIPTION OF THE INVENTION

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

(First Embodiment)

The construction of a three-stage band stopping filter in accordance with a first embodiment of the present invention will be described in Fig. 1 through Fig. 4.

Fig. 1 is a perspective view of a filter, and Fig. 2 is an explosive perspective view before the assembling operation thereof. Referring to Fig. 2, numeral numeral 1 is an approximately six-face unit shaped dielectric block, reference numeral 4 is a dielectric basic plate. Internal conductor formed holes 5, 6, 7 are provided in a dielectric block 1, internal conductors are formed on the inside faces of the internal conductor formed holes 5, 6, 7. An external conductor 12 is formed on the outside faces (five faces) except for a face opposite to the dielectric basic plate 4 of the dielectric block 1. An additional electrode pattern to be described later is formed on a face opposite to the dielectric block 1 of the dielectric basic plate 4. An external conductor 12 is formed on five faces except for the additional electrode formed face so as to form signal input, output electrodes (15 and so on) in one portion of the side face. A dielectric filter shown in Fig. 1 is obtained by the connection between the dielectric block 1 and the dielectric basic plate shown in the Fig. 2.

Fig. 3 is a plan view of the dielectric basic plate 4 shown in Fig. 2. In Fig. 3, reference characters C11, C12, C13 are capacitor electrodes which effect respective capacity connection with the internal conductors within the internal conductor formed holes 5, 6, 7 shown in Fig. 1 and Fig. 2 in a connected condition with the dielectric block 1. Reference characters L1, L2 are inductor electrodes for effecting connections with the respective capacitor electrodes.

Fig. 4 shows an equivalent circuit of the dielectric filter constructed by the above described construction. In Fig. 4, reference characters R1, R2, R3 are resonators by the internal conductors within the internal conductor formed holes 5, 6, 7 shown in Fig. 1, reference characters C1, C2, C3 are capacitors to be formed among the respective internal conductors with respect to the capacitor electrodes C11, C12, C13 shown in Fig. 3. Reference characters L1, L2 are inductors by the electrodes L1, L2 shown in Fig. 3. Reference numerals 14, 15 function as three-stage band stopping filters as signal input, output terminals.

Similar characteristics can be obtained if additional electrodes are formed on a face opposite to the basic plate 4 of the dielectric block 1.

(Second Embodiment)

The construction of the three-stage band passing filter in accordance with the second embodiment of the present invention will be shown in Fig. 5 through Fig. 8.

Fig. 5 is an external appearance view. Fig. 6 is an explosive perspective view before the assembling operation. In Fig. 6, reference numeral 1 is an approximately six-face unit shaped dielectric block, reference numeral 4 is a dielectric basic plate. The internal conductor formed holes 5, 6, 7 are provided in the dielectric block 1. The internal conductors are formed on the inside faces of the internal conductor formed holes 5, 6, 7. An external conductor 12 is formed on the outside faces (five faces) except for the face opposite to the dielectric basic plate 4 of the dielectric block 1. An additional electrode pattern to be described later is formed on the face opposite to the dielectric block 1 of the dielectric basic plate 4. The external conductor 12 is formed on five faces except for the additional electrode forming face so as to form the signal input, output electrodes (15 and so on) on one portion of the side face. The open end portion of the internal conductor is extended so far as the bottom face portion of the dielectric block 1 in the drawing, which is different from Fig. 1 embodiment shown in Fig. 2. One portion of the internal conductor is constructed so as to directly connect to the additional electrode pattern. A dielectric filter shown in Fig. 5 is obtained by the connection between the dielectric block 1 and the dielectric basic plate 4 shown in Fig. 6.

Fig. 7 is a plan view of a dielectric basic plate 4 shown in Fig. 6. In Fig. 7, reference characters C1, C2, C3, C4 are respectively capacitor electrodes formed on the plane of the dielectric basic plate 4, reference characters E1, E2, E3 are electrodes to be connected with the internal conductors drawn out near the open face of the internal conductor formed holes 5, 6, 7 shown in Fig. 6. The open portions of three internal conductors are respectively connected directly with the electrodes E1, E2, E3 with the dielectric block 1 being connected with the dielectric basic plate 4.

Fig. 8 is an equivalent circuit diagram of a dielectric filter shown hereinabove. Referring to Fig. 8, reference characters R1, R2, R3 are resonators by the internal conductors within the internal conductor formed holes 5, 6, 7 shown in Fig. 5 and Fig. 6. Reference characters C1, C2, C3, C4 are capacitors by the electrodes C1, C2, C3, C4 shown in Fig. 7. Reference numerals 14, 15 function as

three-stage band passing filters which become signal input, output terminals by the construction.

(Third Embodiment)

In the second embodiment, a band passing filter is constructed with the use of the dielectric block shown in Fig. 6 and the dielectric basic plate shown in Fig. 7. A band stopping filter can be also constructed by the use of such additional electrode pattern as shown in Fig. 9 as a dielectric basic plate 4. In Fig. 9, reference characteristics E1, E2, E3 are electrodes directly connected with the open portions of the internal conductors. Reference characters C1, C2, C3 are capacitor electrodes which constitute capacitors among the electrodes E1, E2, E3. Reference characters L1, L2 are inductor electrodes. Such a three-stage band stopping filter as shown in Fig. 4 is functioned by the use of the dielectric basic plate having such additional electrode pattern.

The examples of dielectric filters polarized with the use of the additional electrode pattern are shown as fourth through seventh embodiments.

(Fourth embodiment)

Fig. 10 is a perspective view of a dielectric filter in accordance with a fourth embodiment. Fig. 11 is an explosive perspective view before the assembling operation thereof. In Fig. 11, reference numeral 1 is a dielectric block. The internal conductor formed holes 5 through 9 are provided and also, an additional electrode pattern shown in reference character E10 is formed on the connection face with the dielectric basic plate. A portion shown with reference numeral E11 of the additional electrode E10 effects capacity connection with the internal conductor within the internal conductor formed hole 6, and reference character E12 effects capacity connection with the internal conductor within the internal conductor formed hole 8.

Accordingly, the internal conductor within the internal conductor formed holes 6, 8 effects capacity connection through the additional electrode E10. Tip end capacity is constructed in the open portion of the internal conductor within each internal conductor formed holes 5 through 9 so as to effect combed line connection between the resonators. In the same drawing, reference numeral 4 is a dielectric basic plate and an external conductor 12 is formed on five faces except for a face opposite to the dielectric block 1. Electrode patterns which respectively effect capacity connection with the internal conductors within the internal conductor formed holes 5, 9 are provided in the connection condition with the dielectric block 1 so as to draw out these electrodes as signal input, output termi-

nals 14, 15 onto the side of the opposite face (top face in the drawing). Such integral type of dielectric filter as shown in Fig. 10 is obtained by the connection between the dielectric block 1 and the dielectric basic plate 4. In this case, as a second stage and a fourth stage of fifth stages are connected in capacity, it is functioned as a band passing filter having a pole on the low-pass side.

(Fifth embodiment)

Fig. 12 is a perspective view of a dielectric filter in accordance with a fifth embodiment. Fig. 13 is an explosive perspective view before the assembling operation thereof. In Fig. 13, reference numeral 1 is a dielectric block, reference numeral 4 is a dielectric basic plate. A different point from the fourth embodiment shown in Fig. 10 and Fig. 11 is that the additional electrode is provided on the side of the dielectric basic plate 4. In this case, the additional electrode E10 effects the capacity connection between the internal conductors within the internal conductor formed holes 6, 8 with the dielectric block 1 and the dielectric basic plate 4 being connected with each other. The electrodes 14', 15' respectively effect capacity connection with the internal conductors within the internal conductor formed holes 5, 9.

(Sixth Embodiment)

Fig. 14 is a perspective view of an dielectric filter in accordance with a sixth embodiment. Fig. 15 is an explosive perspective view before the assembling operation thereof.

In Fig. 15, reference numeral 1 is a dielectric block, reference numeral 4 is a dielectric basic plate. Internal conductor formed holes 5 through 8 are provided in the dielectric block 1. The additional electrodes E13, E14 are formed on the connection face with the dielectric block 1 are formed on the dielectric basic plate 4. The additional electrode E13 effects capacity connection between the internal conductors within the internal conductor formed holes 5, 6 in a connecting condition with the dielectric block 1. The E14 effects capacity connection between the internal conductors within the internal formed holes 7, 8. Such an integral dielectric filter as shown in Fig. 14 is obtained by the connection between the dielectric block 1 and the dielectric basic plate 4. As the capacity connection is effected between a first stage -- a second stage and between a third stage -- a fourth stage of the four stages in this manner, a band passing filter having the pole in the high-pass is obtained.

(Seventh Embodiment)

Fig. 16 is a perspective view of a dielectric filter in accordance with a seventh embodiment. Fig. 17 is an explosive perspective view before the assembling operation thereof. In Fig. 17, reference numeral 1 is a dielectric block, reference numeral 4 is a dielectric basic plate. The different point from the sixth embodiment shown in Fig. 14 and Fig. 15 is that the dielectric basic plate 4 is adapted to effect the connection in the axial direction with respect to the dielectric block 1. The additional electrodes E13, E14 are formed on the open face side of the dielectric block 1 as shown in Fig. 17. An integral type of dielectric filter shown in Fig. 16 is obtained by the connection of the dielectric basic plate 4 with the dielectric block 1.

In the sixth, seventh embodiments, the band passing filter is made an embodiment. The band stopping filter can be constructed in the same construction if the pattern of the additional electrode is changed.

An example of the dielectric filter constructed with the use of a plurality of dielectric basic plates is shown as an eighth embodiment through an eleventh embodiment.

(Eighth Embodiment)

Fig. 18 is an explosive perspective view before the assembling operation of a dielectric filter in accordance with an eighth embodiment. Fig. 19 is a sectional view after the assembling operation thereof. In Fig. 18, reference numerals 2, 3, 4 are respectively dielectric basic plates. The dielectric basic plates 2 and 3 have respectively semi-circular grooves formed in section on the opposite faces between both of them, and have internal conductors 16, 17, 18 formed on the inside faces thereof. The external conductors 12 are formed on five faces except for the face opposite to the dielectric basic plate 3 of the dielectric basic plate 2 and the external conductors 12 are formed on four side faces of the dielectric basic plate 3. An additional electrode is formed on the opposite face of the dielectric basic plate 3 on the dielectric basic plate 4 and the external conductors 12 are formed on five faces except for the face. In the additional electrode, reference characters Ce11, Ce12, Ce13 effect capacity connection near the open end of the internal conductors 16, 17, 18 as shown in Fig. 19 and reference characters Cs1, Cs2, Cs3 constitute respectively a capacitor between the external conductors 12. Reference numerals L1, L2 function as inductors.

Fig. 20 is an equivalent circuit diagram of a dielectric filter in accordance with the eighth embodiment. In Fig. 20, reference characters R1, R2,

R3 are resonators by the internal conductors 16, 17, 18 shown in Fig. 18. Reference characters Ce1, Ce2, Ce3 are capacitors constructed between the internal conductors 16, 17, 18 and the electrodes Ce11, Ce12, Ce13. Reference numerals 14, 15 function as three-stage band stopping filters which are the signal input, output terminals.

In Fig. 18 through 21, the construction with the basic plates 2 and 3 being separated from each other is an example. A dielectric block with the basic plates 2, 3 being integrated may be used as in the first embodiment.

(Ninth Embodiment)

Fig. 21 is an explosive perspective view before the assembling operation of the dielectric filter in accordance with a ninth embodiment. Fig. 22 is a sectional view after the assembling operation thereof. In both the drawings, reference numerals 2, 3, 4 are respectively dielectric basic plates. The different point from the eighth embodiment shown in Fig. 18 is that shielding electrodes 19, 20 are respectively disposed among the internal conductors 16, 17, 18. The electromagnetic field emitted by the adjacent resonators is screened with the shielding electrodes 19, 20 by the provision of the shielding electrodes 19, 20 in this manner so as to make the combination between the resonators smaller, so that characteristics as the band stopping filter can be retained without wider interval between the resonators.

(Tenth Embodiment)

The sectional view of the dielectric filter in accordance with a tenth embodiment is shown in Fig. 23. The different point from the ninth embodiment shown in Fig. 22 is that the thickness of the shielding electrodes 19, 20 increases so as to provide the larger shielding effect between the resonators. Such shielding electrode has a groove respectively in a dielectric basic plates 23 so that the conductive material is buried within the groove.

(Eleventh Embodiment)

Fig. 24 is an explosive perspective view before the assembling operation of the dielectric filter in accordance with an eleventh embodiment. The different point from the example shown in Fig. 21 in construction is that resonance electrodes 16, 17, 18 composed of strip lines and shielding electrodes 19, 20 are provided on the dielectric basic plate 3. Strip lines used as resonance electrodes in this manner form conductive patterns on the respective dielectric ceramic green sheets so as to effect a manufacturing operation by a layer-built integral

burning operation.

In the eighth through the eleventh embodiments, the band stopping filter is an example. The band passing filter can be constructed in the same construction by the change in the shape of the additional electrode.

Then, an example of a composite integral type dielectric filter is shown hereinafter as a twelfth embodiment.

(Twelfth Embodiment)

Fig. 25 is an explosive perspective view before the assembling operation of the dielectric filter in accordance with a twelfth embodiment. In Fig. 25, reference numeral 1 is a dielectric block, reference numeral 4 is a dielectric basic plate. Internal conductor formed holes 5 through 11 are formed in the dielectric block 1 and an external conductor 12 is formed on five faces except for the connection face with the dielectric basic plate 4. Additional electrode patterns shown with reference characters E15 through E21 and reference numerals L1, L2 are formed on the construction faces with respect to the dielectric block 1 of the dielectric basic plate 4. The external conductors 12 are formed on the other faces and signal input, output electrodes (13, 15 and so on) are extended onto the opposite face side (reverse face in the drawing) to the additional electrode formed face. In the drawing, the electrodes E15, E16 effect the capacity connection between the internal conductors within the internal conductor formed holes 5, 6 and electrodes E17, E18 effect capacity connection between the internal conductors within the internal conductor formed holes 7, 8. The electrodes E19, E20, E21 respectively effect capacity connection with the internal conductors within the internal conductor formed holes 9, 10, 11 so as to respectively connect with inductors L1 and L2 between the electrodes E19 -- E20 and electrodes E20 -- E21. By the construction, the resonators by the internal conductor formed holes 5 through 8 function as four stages of polarized band passing filters, and the resonator by the internal conductor formed holes 9, 10, 11 function as three stages of band stopping filters. An integral type of dielectric filter with such band passing filter and the band stopping filter being made composite can be used as an antenna sharing device, combining device and so on.

In the example of Fig. 25, the dielectric block 1 and the dielectric basic plate 4 are integrally constructed. Either of the dielectric block 1 and the dielectric basic plate 4 may be divided into two. Although the electrode E18 for constructing the final stage of the band passing filter is directly connected to the electrode E19 for constructing the final stage of the band stopping filter so as to

construct the sharing device on the combining device, the connecting operation may be effected by a transmission line for phase matching use or a phase shifting circuit by L, C without direct connection of the connection portion of two filters. The combination of two filters may be made band passing filters or band stopping filters in addition to the example.

(Thirteenth Embodiment)

Fig. 26 is an illustrating view of a dielectric filter in accordance with a thirteenth embodiment.

Although the open portion of the internal conductor or the resonance electrode is formed near the end face of the dielectric block in the first through twelfth embodiments shown hereinabove, the open portion of the internal conductor may be formed within the dielectric block. In Fig. 26, (A) is a cross sectional view with two internal conductor formed holes of the dielectric block being extended through, (B) is a front face view seen from the short-circuit face side of the dielectric block. Internal conductors 16, 17 are formed within the internal conductor formed holes 5, 6 like this, and an open portion is provided therein so as to form the tip end capacity C_s in the portion. The electromagnetic field leakage is further restrained thereby, and influences by the adjacent metallic unit can be further restrained.

The characteristic adjusting method of the dielectric filter will be described hereinafter with reference to Fig. 27 through Fig. 32.

Fig. 27 is a front face view of the dielectric block seen from the short-circuit face side. Reference characters C, D are deleted portions of the conductor of the short circuit face, and the dielectric. The conductor and the dielectric in the region of reference character S1 in Fig. 27 are partially deleted so that the resonance frequency of the resonator by the internal conductor formed hole 5 is lowered. When the conductor and the dielectric are partially deleted in the region of the S2 similarly, the resonance frequency of the resonator by the internal conductor formed hole 6 is lowered. When the conductor and the dielectric are partially deleted in the region of the S12, the coupling degree between both the resonators is lowered. The change examples of the coupling coefficients by the deletion of the conductor and the dielectric are shown in Fig. 28 and Fig. 30. As in Fig. 28, the conductor deletion portion of the width d is provided in the middle position of two coupling holes so as to measure the changes in the coupling coefficients when the area S changes. In Fig. 28, $a = 2.0$ mm, $b = 4.0$ mm, $c = 5.0$ mm. In Fig. 30, the axis of abscissas is a conductor deletion area S, the axis of ordinates is a change ratio of the

coupling coefficients where the coupling coefficient is K_0 in the case of $S = 0$, the coupling coefficient after the conductor deletion is K_a . The coupling coefficient by the conductor deletion area among the internal conductors formed holes on the short-circuit face can be adjusted. Fig. 29 and Fig. 31 show the adjustment examples of the resonance frequency. A conductor deletion portion of the length g, the width f is provided in a location away by a given interval from the internal conductor formed hole as shown in Fig. 29 so as to measure the resonance frequency when the length g has been changed. In Fig. 29, $a = 2.0$ mm, $e = 3.0$ mm, $f = 0.5$ mm. In Fig. 31, the axis of abscissas is length g, the axis of ordinates shows variation amount in the resonance frequency with the resonance frequency in a case of $g = 0$ being a reference. The resonance frequency can be adjusted by the conduction deletion of the internal conductor formed hole periphery on the short-circuit face.

Although the two stages of dielectric resonator is shown in the examples shown in Fig. 27 through Fig. 31, the dielectric resonator of three stages or more can be also similarly applied. In this case, the coupling degree among the resonators can be adjusted by the partial deletion of the conductor and the dielectric in the regions among the open portions S12, S23, ... S_{n-1n} of the internal conductor formed holes on the short-circuit face as shown in Fig. 32. The resonance frequency of the respective resonators can be adjusted by the partial deletion of the conductor and the dielectric of the regions of S1, S2, S3 ... S_n .

When the electrode and dielectric on the open face on the internal conductor open portion formed side are partially deleted, the stress capacity between the resonator and the earth is reduced so that the adjustment may be effected in a direction of raising the resonance frequency.

According to the dielectric resonator of the present invention and the method of manufacturing it, the whole can be made smaller by the sharp deletion of the number of the parts items and the manufacturing cost thereof can be reduced. The different filter characteristics can be given by the designing of the additional electrode layer to be formed within the dielectric. Therefore, a filter having optional characteristics different in specification by the combination of the additional electrode layer can be constructed with the resonator portion being standardized, thus considerably improving the degree of freedom in the designing of the dielectric filter.

(Fourteenth Embodiment)

Fig. 33 and Fig. 34 are views for illustrating the polarization construction of the dielectric filter in a fourteenth embodiment of the present invention. In the fourteenth embodiment, a case of application to a tri-plates type of dielectric filter will be described.

In Fig. 33, reference numeral 21 is a tri-plates type dielectric filter to which the present embodiment construction has been applied. This filter is constructed of one-main faces 22a, 23a of a pair of dielectric basic plates 22, 23 being oppositely stuck. A semi-circular concave portion 24 extending across both the end edges of the basic plates 22, 23 is formed at an interval on the one-main faces 22a, 23a of the respective dielectric basic plates 22, 23 with circular shaped through-holes being formed by both the concave portions 24. The resonance electrode 25 is formed on the internal surface of each concave portion 24. The opposite resonance electrodes 25 are electrically connected with each other. One side face 25a of each resonance electrode 25 is positioned on one-end-edges of the above described dielectric basic plates 22, 23 and the other side face 25b is positioned on the inside away from the other end edges of the dielectric basic plates 22, 23.

An earth electrode 26 is formed on all the faces of the other main faces 22b, 23b of both the dielectric basic plates 22, 23 and the respective sides face 22c, 23c. One side face 25a of each resonance electrode 25 is electrically connected with the earth electrode 26. The input, output electrodes 27 are formed on the left, right side faces 22c, 23c of the dielectric basic plate 22, and the other main face 22b of the lower portion. A gap t is provided between the respective input, output electrodes 27 and the above described earth electrode 26.

The dielectric basic plate 22 of the above described lower portion is of two-division construction of a first basic plate portion 28 and a second basic plate portion 29. Both the basic portions 28, 29 are cut along the axial direction of the concave portion 24 of the dielectric basic plate 22. A pair of polarized electrodes 30 extending towards the central portion from the left, right end edges of the basic plate portion 29 are formed on the front portion of the disconnection face 29a of the second basic plate portion 29. The external end faces 30a of both the polarized electrodes 30 are connected with the above described input, output electrodes 27 so that the polarized capacity for high frequency band use is formed. The polarized electrode 30 is enclosed within the dielectric basic plate 2 by the sticking operation between the above described first, second basic plate portions 28, 29.

The operational effect of the present embodiment will be described hereinafter.

According to the tri-plates type of dielectric filter 21 of the present embodiment, the dielectric basic plate 22 is divided into two portions of first, second basic plate portions 28, 29. The polarized electrode 30 is formed on the disconnected face 29a of the second basic plate portion 29. As the polarized electrode 30 is enclosed within the dielectric basic plate 22, all the faces of the other main faces 22b, 23b of the above described dielectric basic plates 22, 23 may be made earth electrodes 26 so that obstacles to the currents flowing through the earth electrodes 26 can be removed. As a result, the reduction in the insertion loss can be improved by the avoidance of the deterioration in Q_0 value, thus improving the electrical characteristics.

(Fifteenth Embodiment)

In the above described embodiment, the dielectric basic plate 22 of the lower portion is divided into first, second basic plate portions 28, 29. A polarized electrode 30 is formed on the disconnection face 29a of the second basic plate portion 29 and also, the polarized capacity for high frequency band use is provided with the external end faces 30a of both the polarized electrodes 30 being connected with the input, output electrodes 27. The polarized construction of the present invention is not restricted to it. For example, Fig. 35, Fig. 36 respectively illustrate the polarized construction by Fig. 15, Fig. 16 embodiments, where like parts are designated by the same reference numerals as Fig. 1.

The polarized construction of the fifteenth embodiment shown in Fig. 35 is divided into the first, second basic portions 31, 32 in the dielectric basic plate 23 in the upper portion. The polarized electrode 33 is formed in the center portion of the disconnection face 31a of the first basic plate 31 so as to provide the polarized capacity for low frequency band use.

(Sixteenth Embodiment)

In a sixteenth embodiment construction shown in Fig. 36, the first, second basic plate portions 34, 35 are formed with the front portion of the dielectric basic plate 23 being disconnected in an axial right-angled direction of the resonance electrode 25, a pair of polarized electrodes 36 are formed in the longitudinal disconnection face 34a of the first basic plate portion 34, the external end face 36a of the respective polarized electrode 36 is connected with the input, output electrodes 37 formed on the other main face 23b of the above described dielec-

tric basic plate 23 so as to provide the polarized capacity for high frequency band use.

In the above described fourteenth through sixteenth embodiments, a dielectric filter is illustrated by way of example where a concave portion 24 is formed in each dielectric basic plates 22, 23, a resonance electrode 25 is formed on the inner surface of the respective concave portion 24. The present invention can be applied even to a resonance electrode extending in a band shape to a flat shaped dielectric basic plate, and to a resonance electrode only formed on either of the dielectric basic plates.

(Seventeenth Embodiment)

In the above described fourteenth through sixteenth embodiments, the dielectric filter is described by way of example where it has been applied to the tri-plates type dielectric filter. The present invention can be applied even to such a strip line type of dielectric filter as in the seventeenth embodiment shown in, for example, Fig. 37 without restriction to it. The strip line type of dielectric filter 40 has a plurality of resonance electrodes 42 formed extending in a band shape to one main face 41a of the dielectric basic plate 41, and also has an earth electrode 43 formed on the other main face 41b. In this case, the above described dielectric basic plate 41 is divided into first, second basic plate portions 44, 45, and has a polarized electrode 46 formed on the disconnection face 45 of the second basic plate portion 45, with an effect similar to each embodiment.

According to the dielectric filter of the present invention, a polarized electrode for effecting capacity connection mutually with resonance electrodes is formed within the dielectric basic plate, so that the obstacle to the earth currents can be removed with an effect that the insertion loss can be improved with the corresponding avoidance of the deterioration in the Q_0 value.

(Eighteenth Embodiment)

Fig. 38 and Fig. 39 are views for illustrating the dielectric filter by an eighteenth embodiment of the present invention.

In Fig. 38, reference numeral 51 is a dielectric filter of tri-plates construction to which the present embodiment construction has been applied. The dielectric filter 51 is composed with one-main faces 52a, 53a of a pair of dielectric basic plates 52, 53 being oppositely stuck. The semicircular concave portion 54 extending across both the end edges of the basic plates 52, 53 is formed at an interval on one-main faces 52a, 53a of the respective dielectric basic plates 52, 53, and circular through-holes be-

ing formed by both the concave portions 54. The resonance electrode 55 is formed on the internal surface of each concave portion 54 and the opposite resonance electrodes 55 are electrically connected with respect to each other. One side face 55a of each resonance electrode 55 is positioned in one-end edges of the above described dielectric basic plates 52, 53, and the other side face 55b is positioned on the inside away from the other end edges of the dielectric basic plates 52, 53.

Earth electrodes 56 are formed on all the faces of the other main faces 52b, 53b of both the dielectric basic plates 52, 53 and the respective side faces 52c, 53c with one-side face 55a of each resonance electrode 55 being connected on the earth electrode 56. Input, output electrodes 57 are formed on the left, right side faces 52c, 53c of the dielectric basic plates 52 of the above described lower portion and the other main face 52b. A gap t is provided between the respective input, output electrode 57 and the above described earth electrode 56.

The dielectric basic plate 52 of the above described lower portion is of two-division construction of the first basic plate 58 and the second basic plate portion 59. Both the basic plate portions 58, 59 are disconnected along the axial direction of the concave portion 54 of the dielectric basic plate 52.

Stray electrodes 60, coupling electrodes 61, and coil electrodes 62 characterized by the present embodiment are formed in pattern on the cut face 59a of the above described second basic plate portion 59. The respective electrodes 60 through 62 are formed at the same time by, for example, a screen printing method. The above described respective stray electrodes 60 are formed in the positions facing the above described respective concave portions 54. One side thereof is positioned on the front end edge of the second basic plate portion 59 and is connected with the earth electrode 56. The other side of the above described stray electrode 60 is positioned in a gap with respect to one side with the stray capacity C_s being formed between the stray electrodes 60.

The above described respective coupling electrodes 61 are formed opposite to the other side faces 55b of the above described respective resonance electrodes 55 so as to form the coupling capacity C_e with the coupling electrode 61 and the resonance electrode 55. The above described coil electrode 62 is positioned between the respective coupling electrodes 61 so as to form an inductance L . Both the ends of the above described respective coil electrode 62 are connected with the other side of the above described coupling electrode 61, the stray electrode 60, and are connected with the above described input, output terminals 57 through the lead electrode 63. The above described re-

spective stray electrodes 60, the coupling electrodes 61, and the coil electrodes 62 are enclosed within the dielectric basic plate 52 by the sticking operation between the above described first, second basic plate portions 58, 59.

The operational effect of the present embodiment will be described hereinafter.

According to the dielectric filter 51 of the present embodiment, the dielectric basic plate 52 is divided into the first, second basic plate portions 58, 59 so as to pattern-form the stray electrodes 60, the coupling electrodes 61, and the coil electrodes 62 on the cut face 9a of the second basic plate portion 59. The respective electrodes 60 through 62, the resonance electrode 55, the earth electrode 56 and input, output electrodes 57 are formed on the dielectric basic plate 53, the first, second basic plate portions 58, 59 so that it can be manufactured simply by the sticking operation thereof. As a result, the number of the parts can be reduced as compared with the connection with parts such as capacitor elements, coils and so on being engaged on the conventional basic plate. The steps of the manufacturing operations can be omitted, thus correspondingly reducing the cost and improving the productivity. In the present embodiment, the cost can be reduced even from this point, because the conventional metallic case, the coupling terminal, input, output terminals can be made unnecessary.

(Nineteenth Embodiment)

Although the dielectric filter of the tri-plates construction has been described by way of an example in the above described embodiment, the present invention can be applied even to the dielectric filter of such strip line construction as in a nineteenth embodiment shown in, for example, Fig. 40 without restriction to it. The dielectric filter 65 forms a three stage of resonance electrode 67 extending in a band shape on one main face 66a of the dielectric basic plate 66, and also, forms the earth electrode 68 on the other main face 66b. Even in this case, the above described dielectric basic plate 66 is divided into the first, second basic plate portions 69, 70, and the above described stray electrode 60, the coupling electrode 61 and the coil electrode 62 are pattern formed on the cut face 70a of the second basic plate portion 70 with an effect similar to the above described embodiment.

(Twentieth Embodiment)

Fig. 41 and Fig. 42 are views for illustrating a dielectric filter by a twentieth embodiment in accordance with the present invention where like parts

are designated by the same reference numerals as in Fig. 1.

The dielectric filter 51 in the present embodiment is approximately the same as in the above described embodiment. In the present embodiment, the shielding electrode 75 is formed between the adjacent resonance electrodes 55 of one main surface 52a of the above described dielectric basic plate 52, and the both the end faces 75a of the shielding electrode 75 is connected with the earth electrode 56.

In accordance with the present embodiment, as both the end faces 75a form the shielding electrode 75 connected with the earth electrode 56 between the adjacent resonance electrodes 55 of the dielectric basic plate 52, electric force lines emitting from both the resonance electrodes 55 are absorbed by the above described shielding electrode 75 and the mutual influence forces become weak so that the characteristics are not deteriorated if the above described both the resonance electrodes 55 are formed in proximity. As a result, the width size of the dielectric basic plate 52 may be made smaller, and all the parts may be made smaller in size with effects similar to the above described embodiment. The characteristic adjustment can be also effected easily by the formation of the above described shielding electrode 75.

When the shielding electrode is formed on the dielectric filter of the above described strip line construction, the shielding electrode 75 (shown with two-dot chain lines) are formed between the adjacent resonance electrodes 67 of the dielectric basic plate 65 as shown in Fig. 40 so as to connect both the end faces 75a with the earth electrode 68. An effect similar to the above described embodiment can be obtained even in this case.

(Twenty First Embodiment)

In the above described embodiment, although a case where the shielding electrode has been formed on the surface of the dielectric basic plate is described by way of example, the present invention is not restricted to it. In the twenty first embodiment shown in, for example, Fig. 43, narrow grooves 76 are formed among the resonance electrodes 55 of the respective dielectric basic plates 52, 53 so as to fill the electrode within the groove 76 for forming the shielding electrode 27. In such a case, the shielding property can be further improved and the dielectric basic plate can be further made smaller in size.

In accordance with such a invention as described hereinabove, coupling electrodes, stray electrodes and coil electrodes are pattern-formed within the dielectric basic plate so as to reduce the number of the parts and lower the cost, with a

effect that the productivity can be improved with the steps of manufacturing operations being omitted. In the invention of the claim 2, shielding electrodes to be connected with the earth electrode are formed between the resonance electrodes of the above described dielectric basic plate so that the resonance electrode interval can be narrowed without the deterioration of the characteristics, with an effect that the dielectric basic plate can be made correspondingly smaller in size.

(Twenty Second Embodiment)

The construction of the dielectric filter in accordance with a twenty second of the present invention will be described in Fig. 45 through Fig. 48.

Fig. 45 is an explosive perspective view before the assembling operation of the filter. Fig. 2 is a perspective view after the assembling operation thereof. In Fig. 45, reference numerals 82, 83, 84 are respectively dielectric basic plates. The dielectric basic plates 82 and 83 have semi-circular grooves respectively in both the connection faces and also, have internal conductors 96, 97, 98, 99 formed on the inside faces thereof. The tip end capacity is provided by the formation of the open portion near one end portion of each groove is provided in each internal conductor so as to effect column-in connection between the resonators. The external conductor 92 is formed except for the outgoing portion vicinity of the signal input, output electrodes is formed on four side faces of the dielectric basic plate 83 except for the connection faces of the dielectric basic plates 82, 84. The external conductors 92 are fully formed on five faces except for a face opposite to the dielectric basic plate 83 of the dielectric basic plate 82. On the dielectric basic plate 84, the coupling electrodes E93, E94 are formed on the connection face of the dielectric basic plate 83 and these coupling electrodes are extended so far as one portion of the reverse face through the side face of the dielectric basic plate 84. Electrodes (95 and so on) extended so far as one portion of the reverse face from the side face of the dielectric basic plate 84 are used as signal input, output electrodes. The external conductors 92 are formed on four side faces and the dielectric basic plate 84 and the bottom face thereof except for the signal input, output electrode formed regions. Such a dielectric filter as shown in Fig. 46 is obtained by the layer-building operation of the three dielectric basic plates 82, 83, 84 shown in Fig. 45. Reference numerals 85 through 88 in Fig. 46 are internal conductor formed holes formed with grooves.

Fig. 47 is an equivalent circuit diagram of a dielectric filter in accordance with the embodiment of Fig. 22. In Fig. 47, reference characters Ra, Rb,

Rc, Rd are resonators by the internal conductors 96, 97, 98, 99 shown in Fig. 1. Reference characters Ca, Cb are capacitor to be formed between the resonators Ra, Rb and the signal input, output terminals 94, reference characters Cc, Cd are capacity to be formed between the resonators Rc, Rd and the signal input, output terminals 95. Fig. 48 is a characteristic view of a filter in accordance with the twenty second embodiment. A damping pole P is caused on the high-pass side of the passing band as shown in Fig. 48, by the capacity Cb, Cc shown in Fig. 47.

(Twenty third Embodiment)

The construction of the dielectric filter in accordance with a twenty third embodiment is shown in Fig. 49 through Fig. 52.

Fig. 49 is an explosive perspective view before the assembling operation of the dielectric filter. Fig. 50 is a perspective view after the assembling operation thereof. In Fig. 49, reference numerals 82, 83, 84 are respectively dielectric basic plates. An external conductor 92 is formed on five faces except for a face opposite to the dielectric basic plate 83. On the dielectric basic plates 83 and 84, the semi-circular (sectional) grooves are formed respectively on both the connection faces and internal conductors 96, 97, 98, 99, 100 are formed on the inside faces thereof. The tip end capacity is provided by the formation of the open portion near the one end portion of each groove in each internal conductor so as to effect combed line connection among the resonators. On the dielectric basic plate 83, the external conductor 92 is formed on four side faces thereof, and the coupling electrodes E90 is formed on the face opposite to the dielectric basic plate 82. Portions shown with E91, E12 of the coupling electrode E90 form positions for effecting capacity connection respectively on the internal conductors 97, 99 formed on the reverse face side in the view of the dielectric basic plate 83. The external conductor 92 is formed, on the dielectric basic plate 84, on the four side faces and the bottom face in the drawing except for the formed regions of the signal input, output electrodes (95 and so on). The dielectric filter provided with a coupling electrode layer together with the internal conductor formed holes 85 through 89 is provided in the dielectric interior as shown in Fig. 50 by the layer-building operation of three dielectric basic plates 82, 83, 84 shown in Fig. 49.

Fig. 51 is an equivalent circuit diagram of a dielectric filter in accordance with the embodiment of Fig. 23. Fig. 52 is its characteristic view. In Fig. 51, reference characters Ra through Re are resonators by the internal conductors 96 through 100 shown in Fig. 49. Reference characters Ca, Ce are

capacity to be caused between the internal conductors 96, 100 shown in Fig. 49 and the signal input, output electrodes. Reference characters Cb, Cd are capacity to be caused between the internal conductors 97, 99 shown in Fig. 49 and the coupling electrodes E91, E92. The band passing filter characteristics having a damping pole P on the low-pass side is obtained as shown in Fig. 52 with the capacity connection being effected between the second stage and the fourth stage among five stages.

(Twenty Fourth Embodiment)

Fig. 53 is a perspective view before the assembling operation of the dielectric filter in accordance with a twenty fourth embodiment. Fig. 54 is a perspective view after the assembling operation thereof. In Fig. 53, reference numerals 82, 83, 84 are respectively dielectric basic plates, grooves are formed respectively on the connection face of the dielectric basic plates 83 and 84, and on the connection face between the dielectric basic plate 82 and the dielectric basic plate 84 so that the internal conductor formed holes 85 through 88 may be formed in an integrated condition as shown in Fig. 54 with these being connected. The internal conductors 96 through 99 are respectively formed on the inside faces thereof. The coupling electrodes E93, E94 are provided on the connection face between the dielectric basic plate 82 and the dielectric basic plate 83 and are respectively drawn out as the signal input, output electrodes 94, 95 onto the top face in the drawing of the dielectric basic plate 83. In such construction, the coupling electrode E93 is connected in capacity with the internal conductors 96, 97, and the coupling electrode E94 is connected in capacity with the internal conductors 98, 99. Therefore, a dielectric filter having damping pole is obtained on the high-pass side.

A dielectric filter using the dielectric block with a plurality of internal conductor formed holes being formed in it will be shown hereinafter as the embodiments of twenty fifth through twenty eighth embodiments.

(Twenty Fifth Embodiment)

Fig. 55 is an explosive perspective view of a dielectric filter in accordance with a twenty fifth embodiment. Fig. 56 is a perspective view after the assembling operation thereof. In Fig. 55, reference numeral 81 is a dielectric block. Reference numeral 84 is a dielectric basic plate. Internal conductor formed holes 85 through 89 are provided in the dielectric block 81, and also, an external conductor 92 is formed on almost all the faces except

for the connection face of the dielectric basic plate 84. A coupling electrode shown with reference numeral E90 is shown, on the dielectric basic plate 84, on the connection face with respect to the dielectric block 81. Portions shown with E91, E92 of the coupling electrode E90 are respectively connected in capacity with the internal conductors within the internal conductor formed holes 86, 88. The electrodes 94', 95' for effecting capacity connection respectively with the internal conductors within the internal conductor formed holes 85, 89 with the connection condition with the dielectric block 81 are provided on the dielectric basic plate 84, and these electrodes are drawn out as the signal input, output electrodes on the side of the opposite face (the bottom face in the drawing) through the side face. The dielectric filter shown in Fig. 56 is obtained by the connection between the dielectric block 81 and the dielectric basic plate 84. In this case, it functions as a band passing filter having the damping pole on the low-pass side as the second stage is connected in capacity with the fourth stage among the five stages.

(Twenty Sixth Embodiment)

Fig. 57 is an explosive perspective view before the assembling operation of the dielectric filter in accordance with a twenty sixth embodiment. Fig. 58 is a perspective view after the assembling operation thereof. In Fig. 57, reference numeral 81 is a dielectric block, reference numeral 84 is a dielectric basic plate. The different point from the twenty fifth embodiment shown in Fig. 55 and Fig. 56 is that the coupling electrode E90 is provided on the dielectric block 81 side. Even in the case, the coupling electrode E90 is connected in capacity between the internal conductors within the internal conductor formed holes 86, 88 with the dielectric block 81 being connected with the dielectric basic plate 84.

(Twenty Seventh Embodiment)

Fig. 59 is an explosive perspective view before the assembling operation of a dielectric filter in accordance with a twenty seventh embodiment. Fig. 60 is a perspective view after the assembling operation thereof.

In Fig. 59, reference numeral 81 is a dielectric block, reference numeral 84 is a dielectric basic plate. Internal conductor formed holes 85 through 88 are provided in the dielectric block 81. On the dielectric basic plate 84, the coupling electrodes E93, E94 are formed on the connection face between the dielectric block 81. The coupling electrode E93 effects capacity connection between the internal conductors within the internal conductor

formed holes 85, 86 in a connection condition with respect to the dielectric block 81. Reference numeral E94 effects the capacity connection among the internal conductors within the internal conductor formed holes 87, 88. Such a dielectric filter as shown in Fig. 60 is obtained by the connection between the dielectric block 81 and the dielectric basic 84. As the capacity connection is effected between a first stage -- a second stage and between a third stage -- a fourth stage among four stages in this manner, a band passing filter having a pole in the high pass is obtained.

(Twenty Eighth Embodiment)

Fig. 61 is an explosive perspective view before the assembling operation of the dielectric filter in accordance with a twenty eighth embodiment. Fig. 62 is a perspective view after the assembling operation thereof.

In Fig. 61, reference character 81 is a dielectric block, reference numeral 84 is a dielectric basic plate. The different portion from the twenty seventh embodiment shown in Fig. 59 and Fig. 60 is that the dielectric basic plate 84 is connected in an axial direction with respect to the dielectric block 81. Accordingly, coupling electrodes E93, E94 are formed on the open face side of the dielectric block 81 as shown in Fig. 61. A dielectric filter shown in Fig. 62 is obtained by the connection of the dielectric basic plate 84 with the dielectric block 81.

(Twenty Ninth Embodiment)

Fig. 63 is an explosive perspective view of a dielectric filter in accordance with a twenty ninth embodiment. In Fig. 63, reference numerals 82, 83 are respectively dielectric basic plates. The earth electrode 92 is formed on five faces except for the connection face with respect to the dielectric basic plate 83 is formed on the dielectric basic plate 82. On the dielectric basic plate 83, the coupling electrode E90 is formed together with five resonance electrodes 96 through 100 are formed on the connection face with the dielectric basic plate 82. Also, the earth electrode 92 is formed on the four side faces of the dielectric basic plates 83 and the bottom face in the drawing. The portions shown with reference numerals E91, E92 of the coupling electrode E90 are connected in capacity near the open ends of the resonance electrodes 97, 99. A dielectric filter having the damping pole on the low-pass side is obtained by the connection between the dielectric basic plates 82, 83 shown in Fig. 63.

(Thirtieth Embodiment)

Fig. 64 is an explosive perspective view of a dielectric filter in accordance with a thirtieth embodiment. Reference characters 82, 83 are respectively dielectric basic plates in Fig. 64. Semi-circular (section) grooves are formed respectively on the connection face of the dielectric basic plates 82, 83. An internal conductor shown with reference numerals 96 through 100 is formed on the inside face thereof. An external conductor 92 is formed on the four side faces and the top face in the drawing on the dielectric basic plate 82. An external conductor 92 is formed on the four side faces and the top face in the drawing is formed on the dielectric basic plate 83. The coupling electrode shown with E10 is formed on the connection face with respect to the dielectric basic plate 2 and within the groove on the dielectric basic plate 83. The portions shown with E91, E12 of the coupling electrode E90 are connected in capacity with the open end vicinity of the internal conductors 97, 99. The second stage and the fourth stage of the five stages are connected in capacity. The dielectric filter having the damping pole is obtained on the low-pass side by the connection of the dielectric basic plates 82, 83.

In accordance with the dielectric resonator and its manufacturing method of the present invention, polarized small sized dielectric resonator can be manufactured with lower price by the sharp reduction of the number of the parts. Qo of the resonator is not reduced as the coupling electrode formed regions is not provided in one portion of the earth electrode, so that the band passing filter with less insertion loss can be obtained. As the different filter characteristics can be given by the designing of the coupling electrode layer to be formed within the dielectric, the dielectric filter having optional characteristics different in specification by the combination with respect to the coupling electrode layer can be constructed with the resonator portions being standardized.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as included therein.

Claims

1. A dielectric resonator comprising; a plurality of resonance electrodes, dielectrics interposed between these resonance electrodes and earth electrodes, and additional electrode layers are constructed within the dielectric.

2. A dielectric resonator comprising a plurality of resonance electrodes, dielectrics interposed between these resonance electrodes and earth electrodes, and coupling electrode layers provided within the dielectric to effect capacity connection with a plurality of resonance electrodes. 5
3. A dielectric filter comprising an earth electrode formed on the other main face of a dielectric basic plate, a plurality of resonance electrodes formed on one main face, one side face of the resonance electrode being connected with the above described earth electrode so as to have coupling electrodes, stray electrodes and coil electrodes pattern-formed on the portion facing the respective resonance electrodes within the dielectric basic plate. 10 15
4. A dielectric filter as defined in claim 3, where the shielding electrode is formed between the adjacent resonance electrodes on one main face of the above described dielectric basic plate, and both the ends of the shielding electrode are connected with the above described earth electrode. 20 25
5. Polarized construction of a dielectric filter comprising; a plurality of resonance electrodes formed on one main face of the dielectric basic plate, an earth electrode formed on the other main face of the dielectric basic plate, one side face of the resonance electrode being connected with the earth electrode, and the polarized electrode being formed within the dielectric basic plate in the polarized construction for adding a polarized electrode, to the filter, connecting in polarized capacity the resonance electrodes. 30 35 40
6. A method of manufacturing a dielectric resonator comprising the steps of connecting a plurality of basic plates including a dielectric basic plate with a plurality of resonance electrode films being formed on it and a dielectric basic plate with an additional electrode film being formed on it, and manufacturing a dielectric resonator having the additional electrode layer within the dielectric interior. 45 50
7. A method of manufacturing a dielectric resonator comprising the steps of connecting a dielectric basic plate with a plurality of resonance electrode films, additional electrode films being formed on it opposite to these resonance electrode films, with a plurality of basic plates including the other dielectric basic plate, and manufacturing a dielectric resonator having an additional electrode layer on the dielectric interior. 55
8. A method of manufacturing a dielectric resonator comprising the steps of composing a dielectric unit having a plurality of resonance electrode films formed therein, connecting a dielectric basic plate with the additional films being formed on it with the above described dielectric unit, and manufacturing a dielectric resonator having an additional electrode layer within the dielectric.
9. A method of manufacturing a dielectric resonator comprising the steps of using a dielectric ceramic green sheet with a plurality of resonance electrode films being formed on it, a dielectric ceramic green sheet with additional electrode films being formed on it, effecting an integral laminated burning operation, and manufacturing a dielectric resonator having an additional electrode layer within the dielectric.
10. A method of manufacturing a dielectric resonator comprising the steps of connecting a dielectric basic plate with a plurality of resonance electrode films being formed on it with a plurality of basic plates including a dielectric basic plate with coupling electrode films being formed on it, and manufacturing a dielectric resonator having coupling electrode layers within the dielectric.
11. A method of manufacturing a dielectric resonator comprising the steps of connecting a dielectric basic plate with a plurality of resonance electrode films and coupling electrode films being formed opposite to these resonance electrode films with a plurality of basic plates of the other dielectric basic plate, and manufacturing a dielectric resonator having the coupling electrodes layers within the dielectric.
12. A method of manufacturing a dielectric resonator comprising the steps of constituting a dielectric unit having a plurality of resonance electrode films formed therein, connecting a dielectric basic plate with coupling electrode films being formed on it with the above described dielectric unit, and manufacturing a dielectric resonator having coupling electrode layers within the dielectric.

Fig. 1

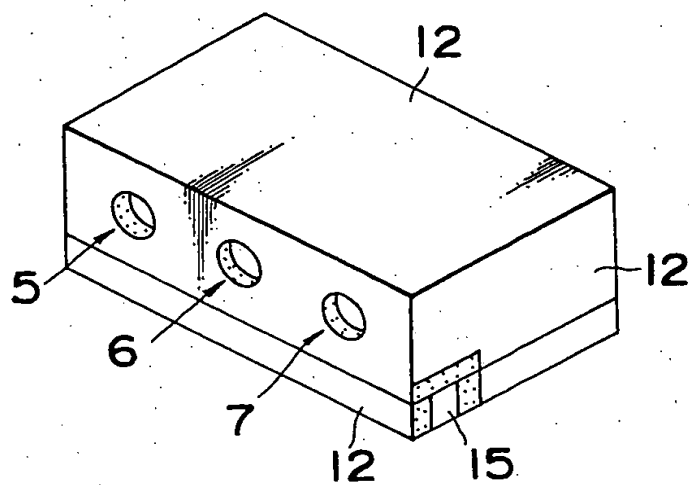


Fig. 2

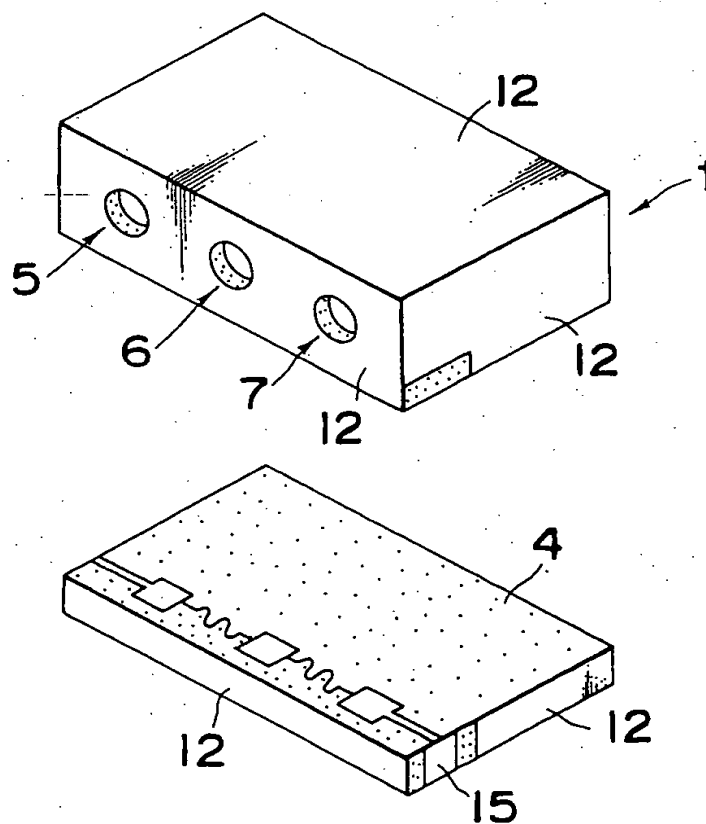


Fig. 3

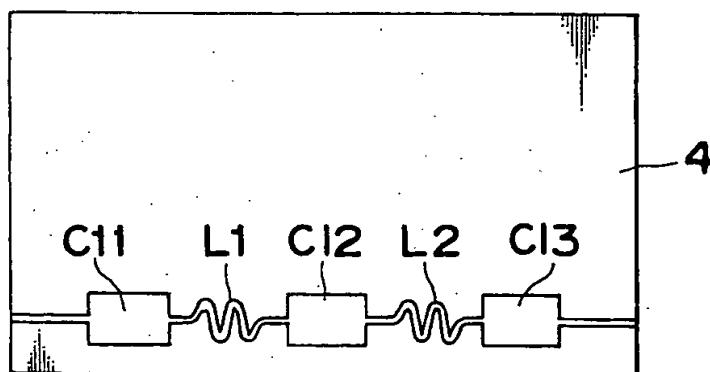


Fig. 4

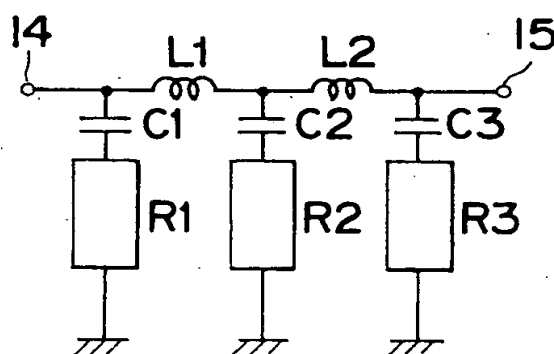


Fig. 5

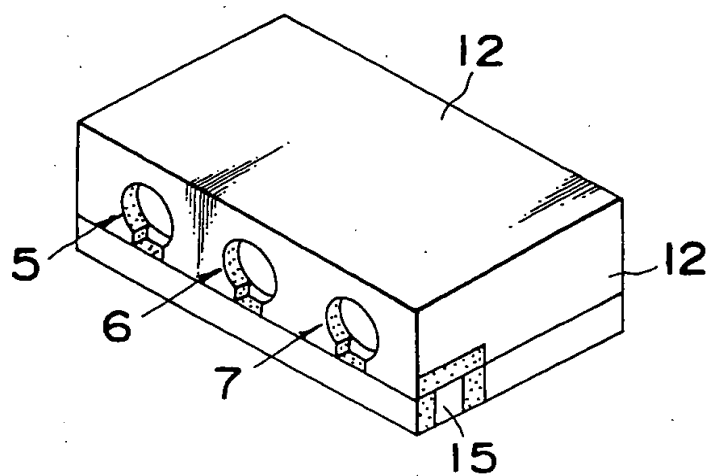


Fig. 6

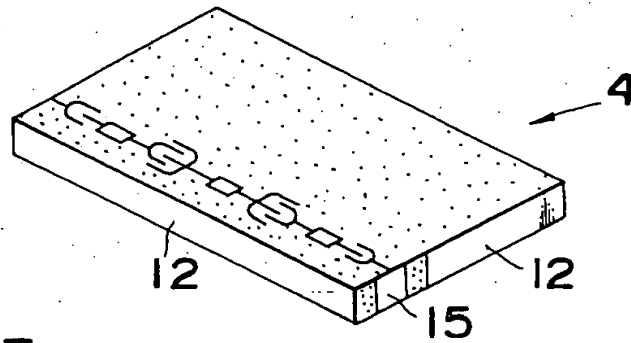
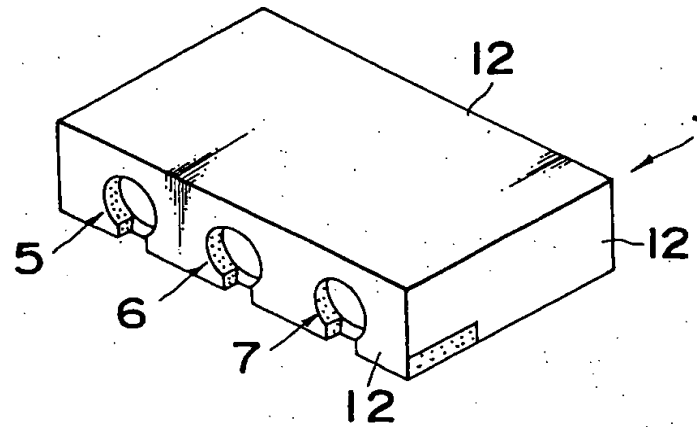


Fig. 7

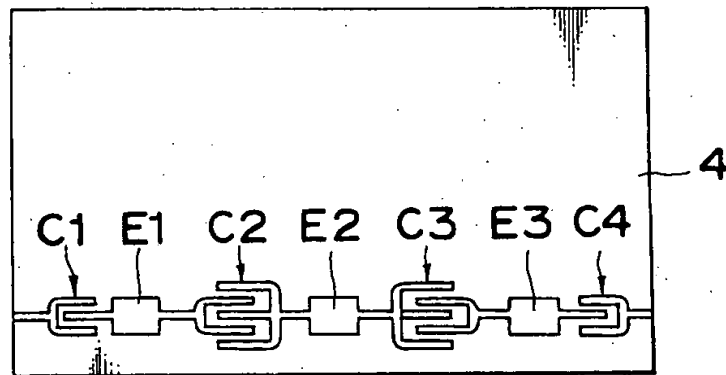


Fig. 8

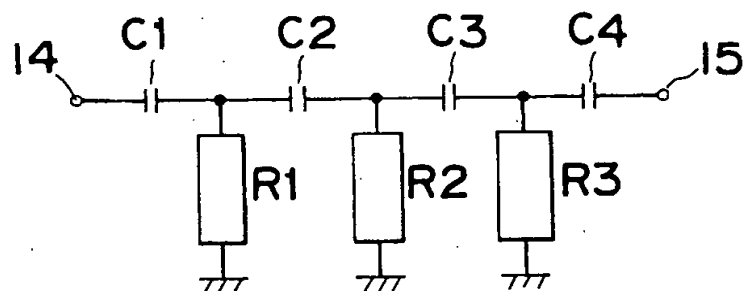


Fig. 9

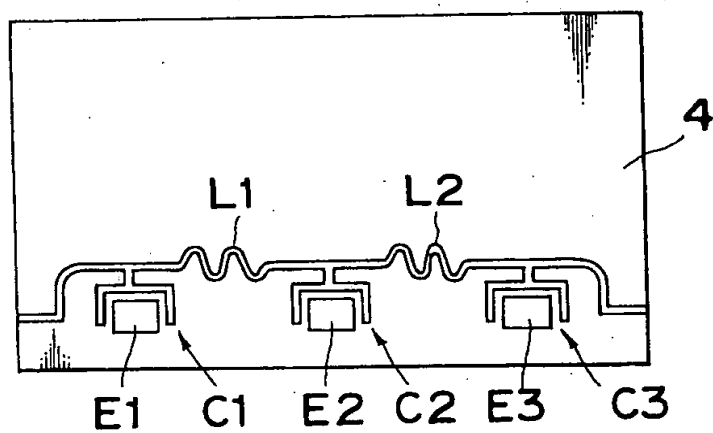


Fig. 10

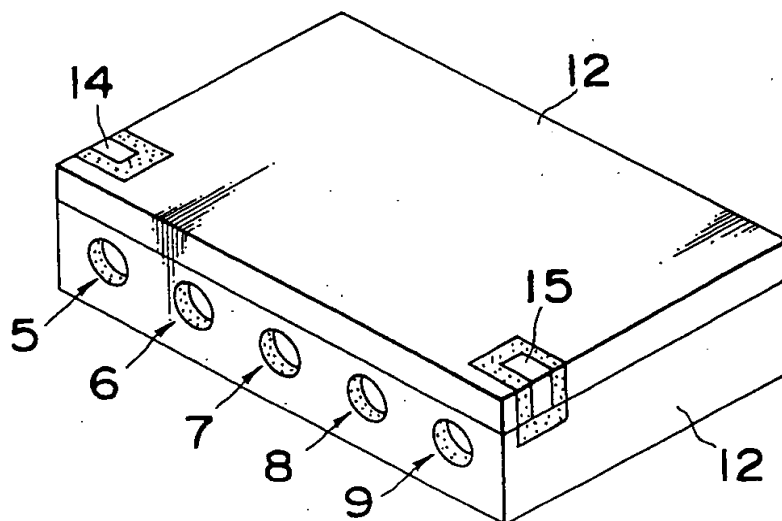


Fig. 11

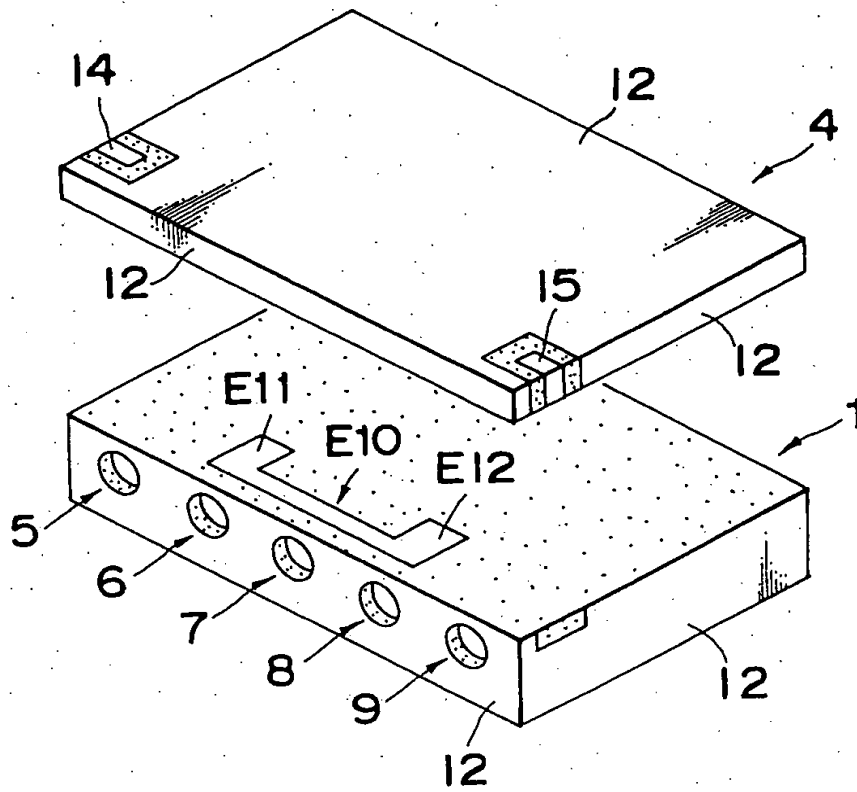


Fig. 12

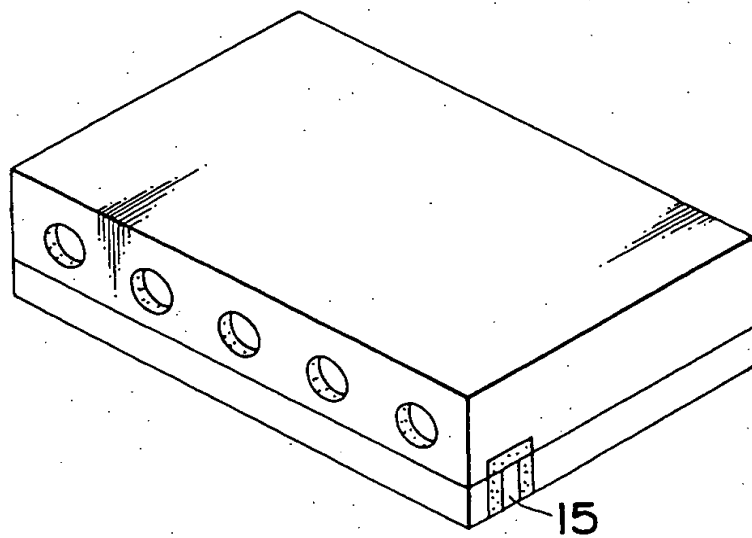


Fig. 13

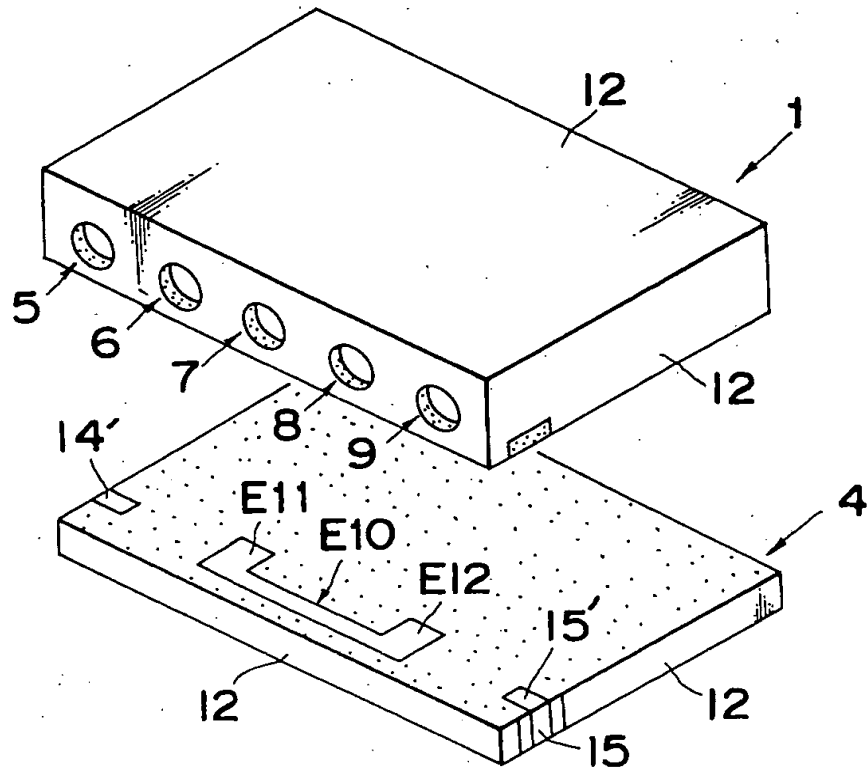


Fig. 14

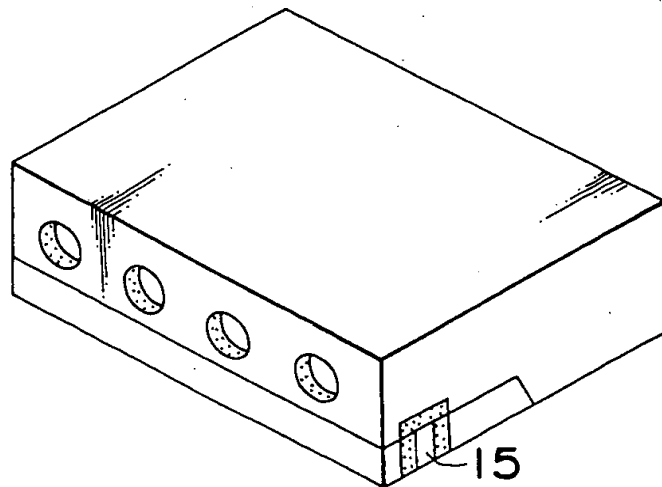


Fig. 15

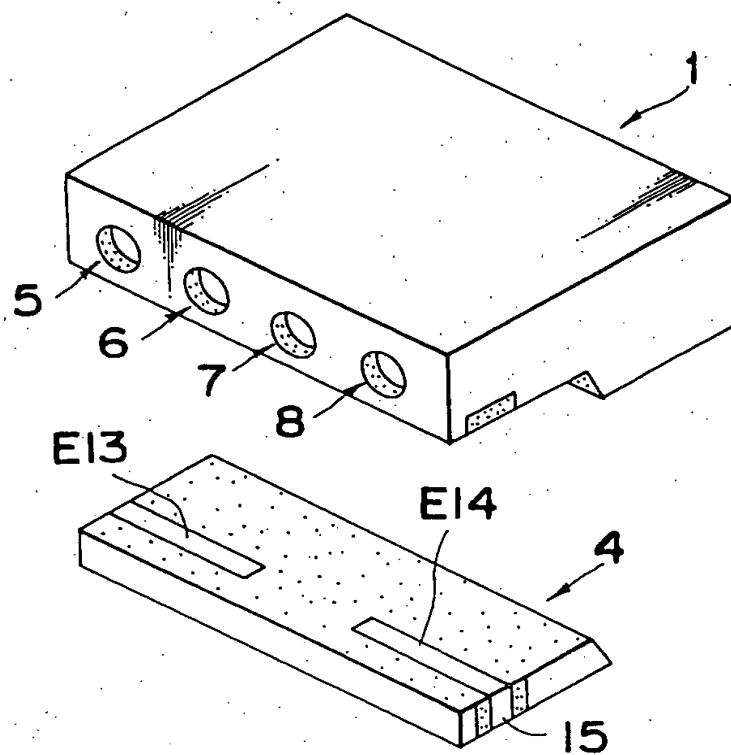


Fig. 16

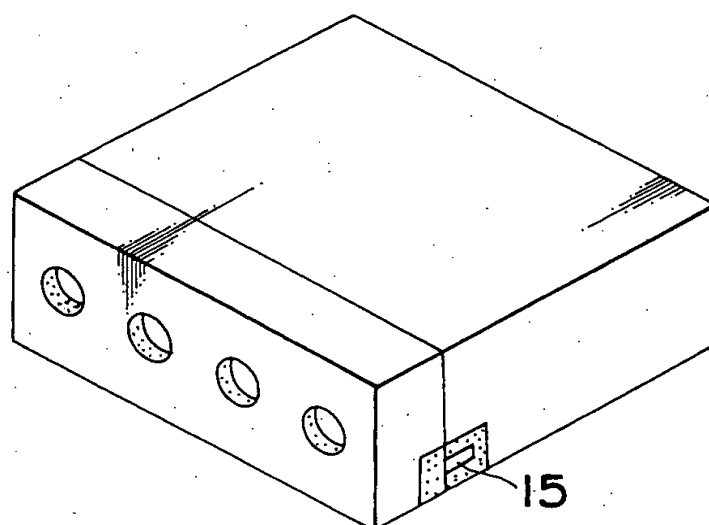


Fig. 17

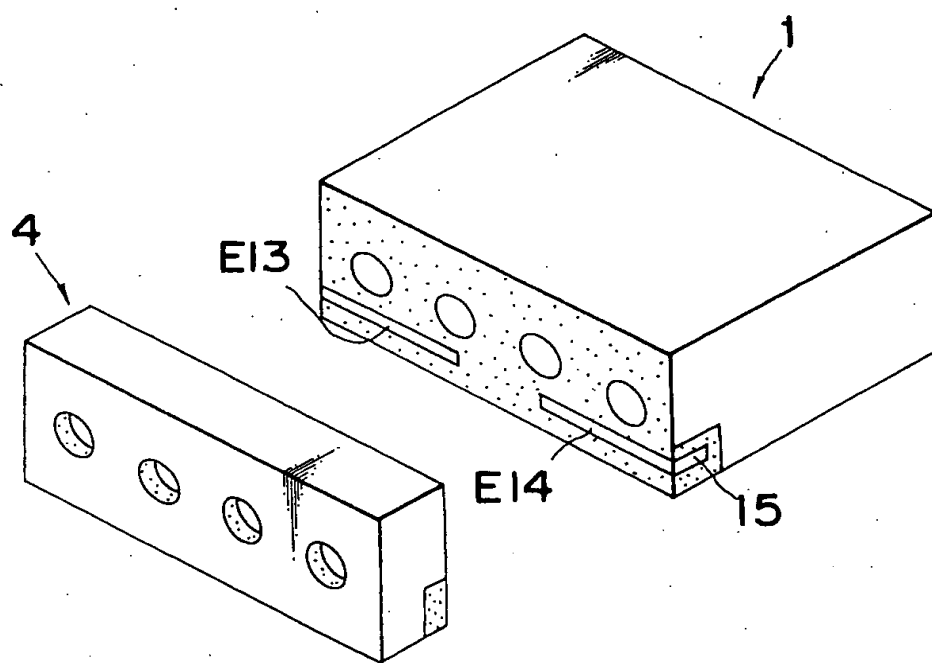


Fig. 18

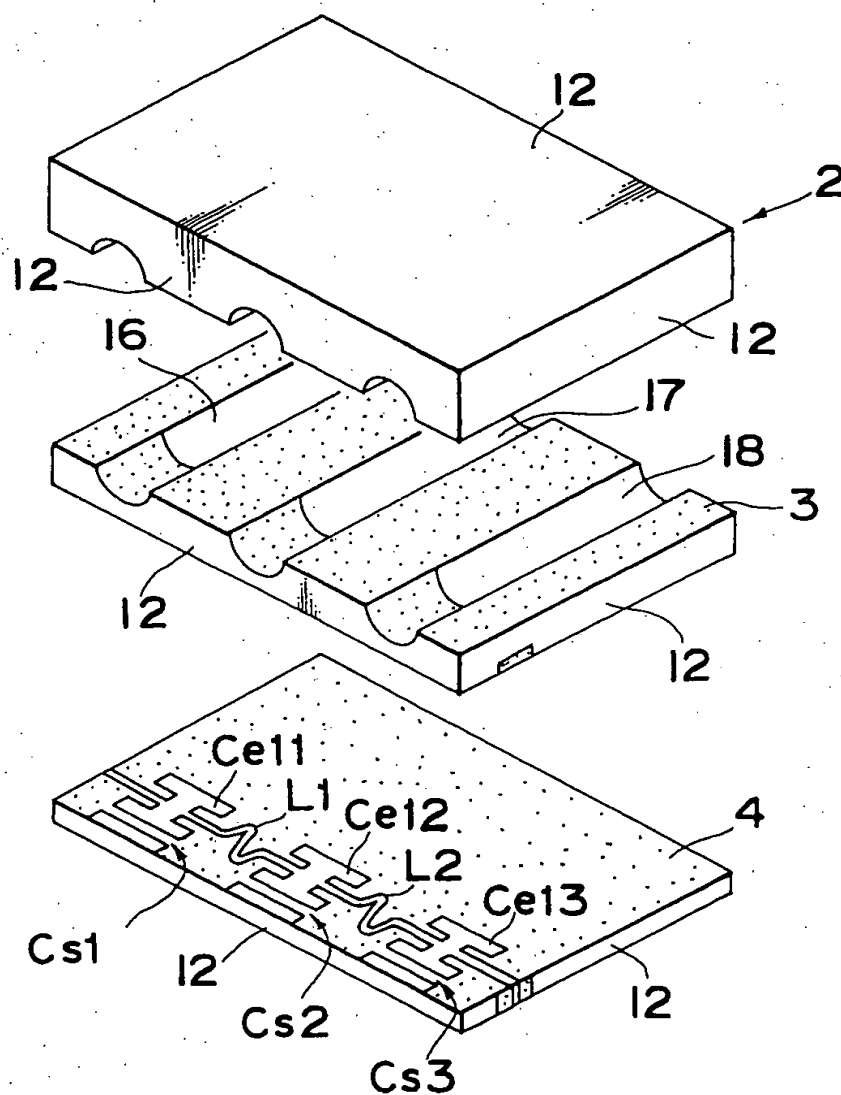


Fig. 19

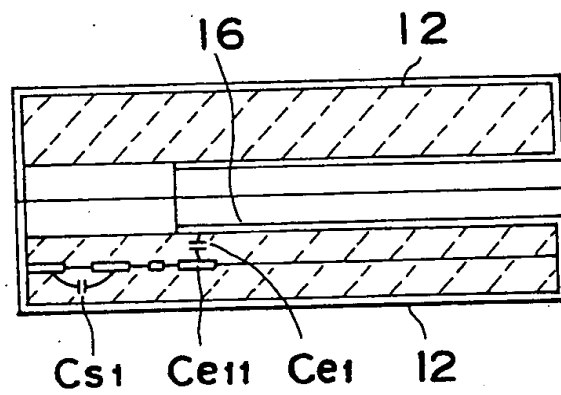


Fig. 20

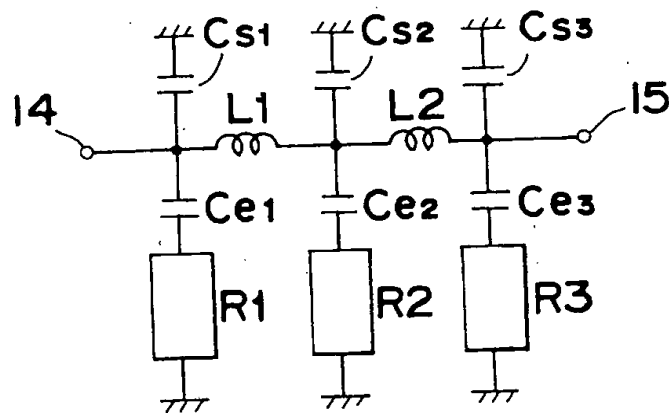


Fig. 21

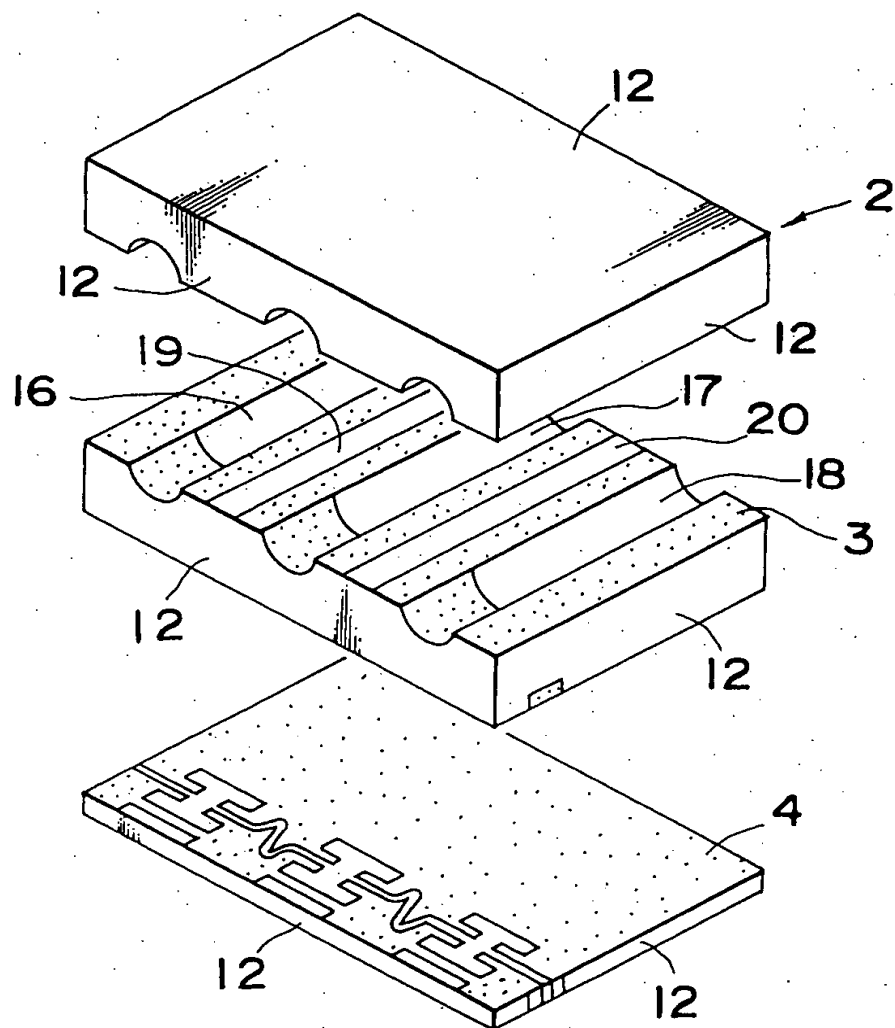


Fig. 22

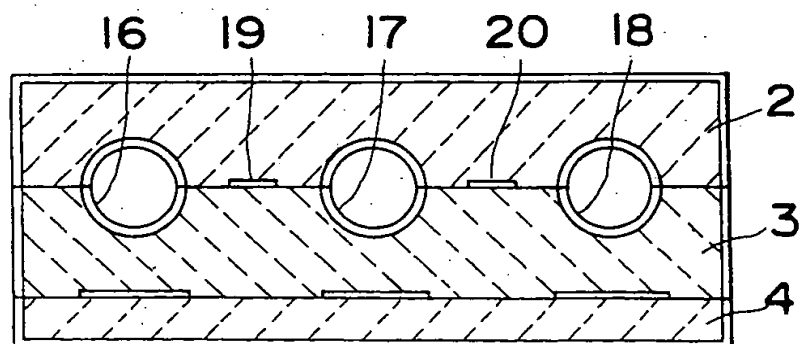


Fig. 23

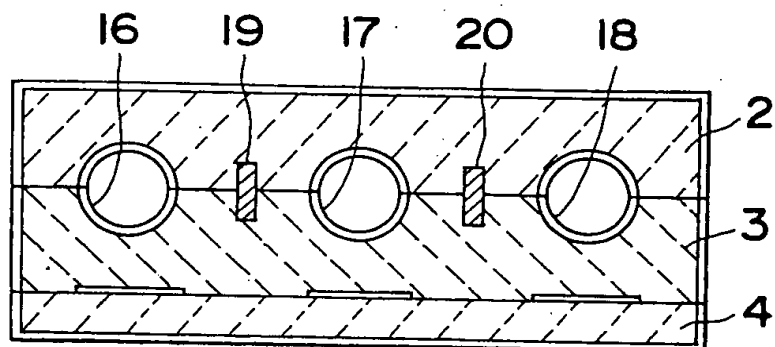


Fig. 24

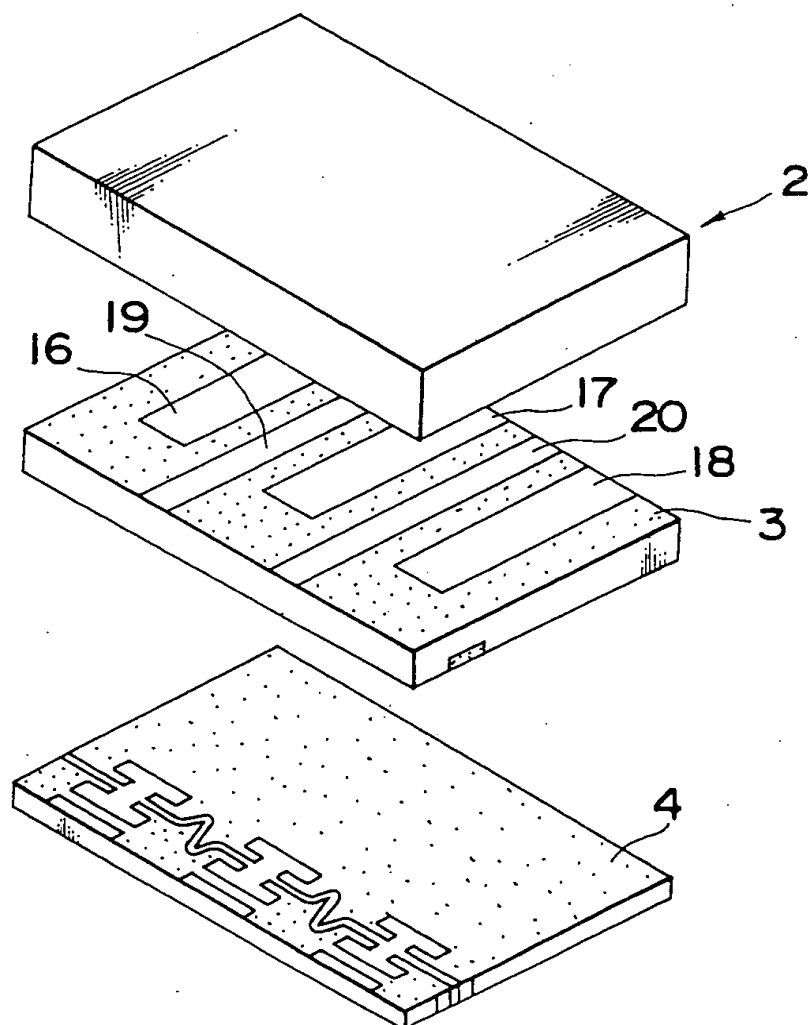


Fig. 25

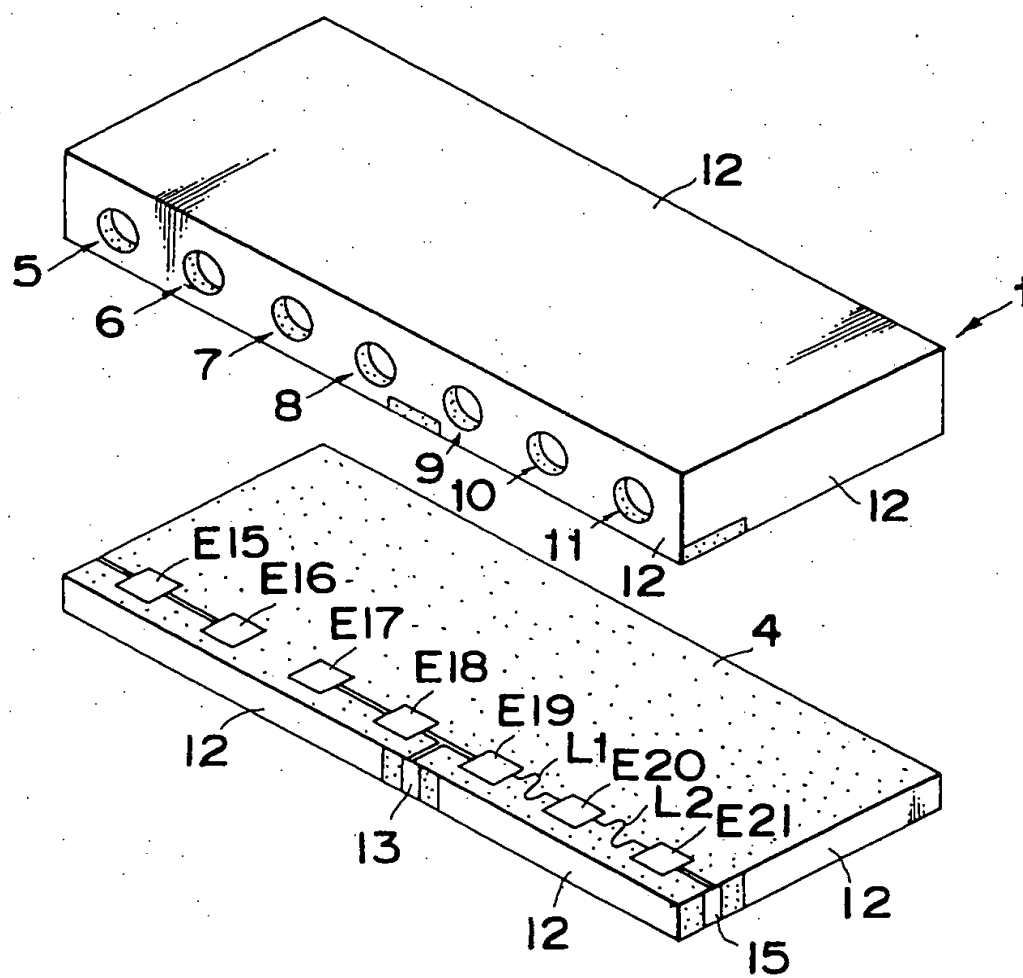


Fig. 26

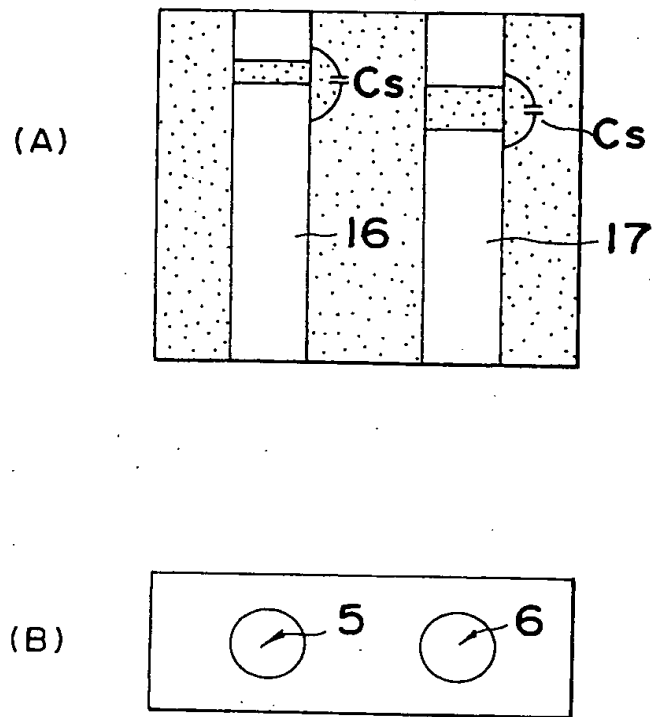


Fig. 27

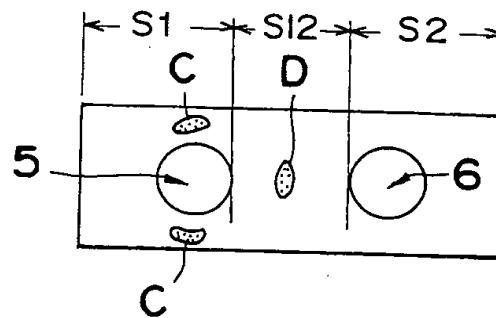


Fig. 28

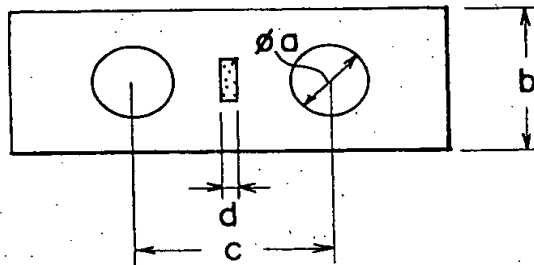


Fig. 29

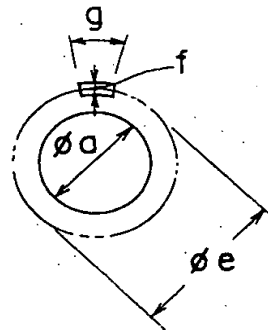


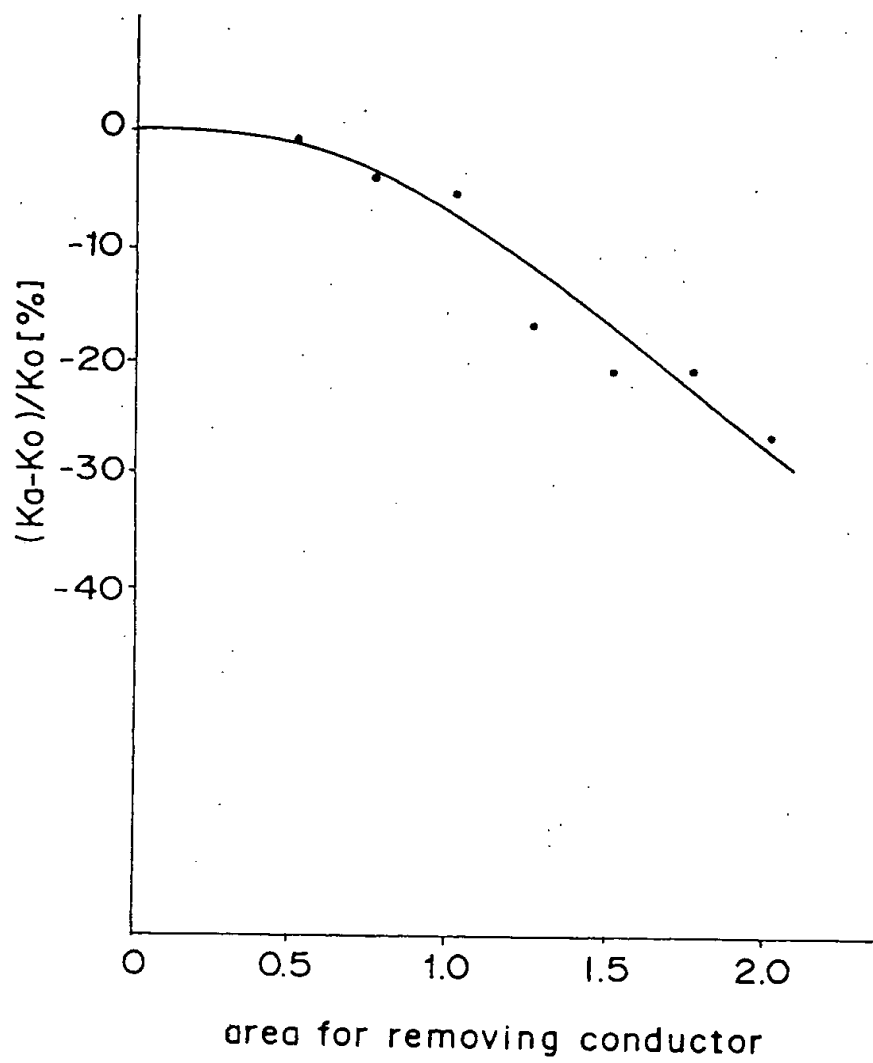
Fig. 30

Fig. 31

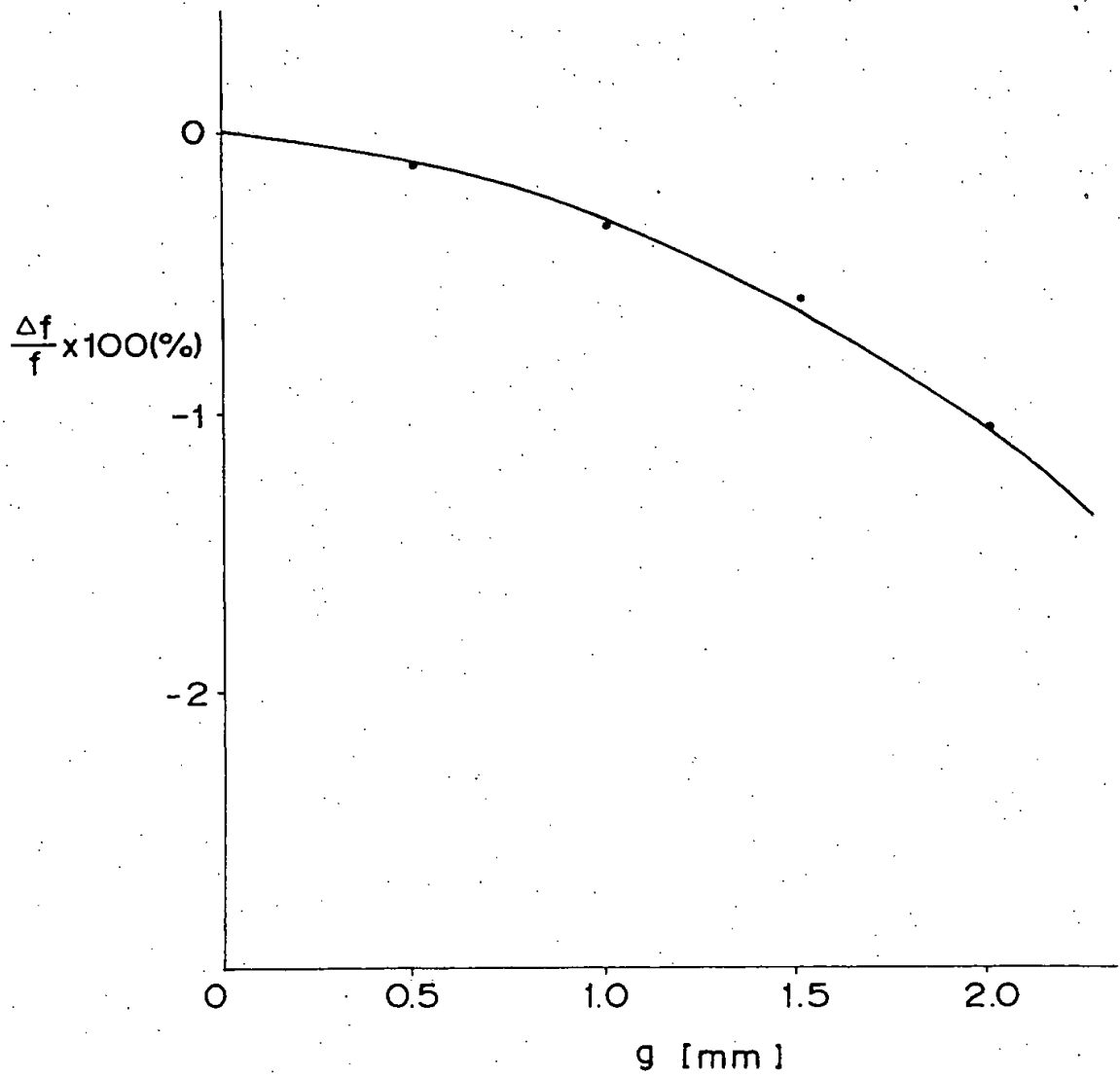


Fig. 32

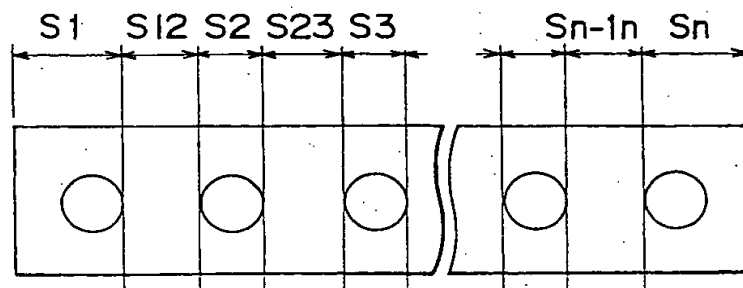


Fig. 33

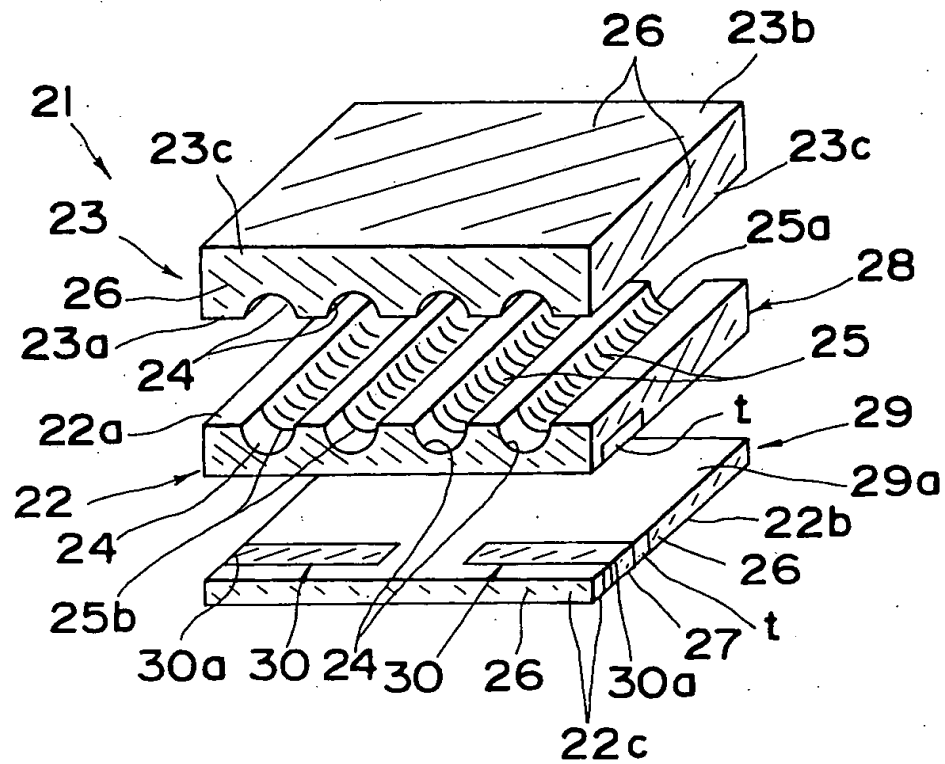


Fig. 34

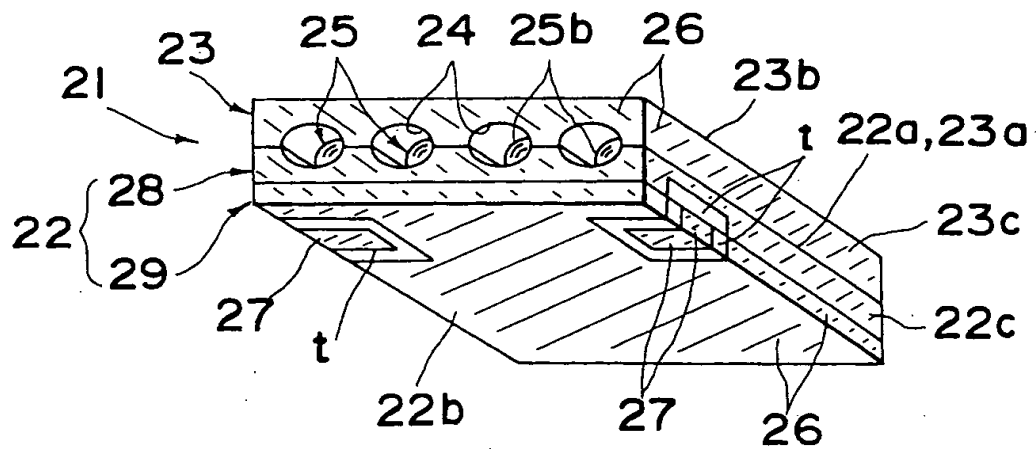


Fig. 35

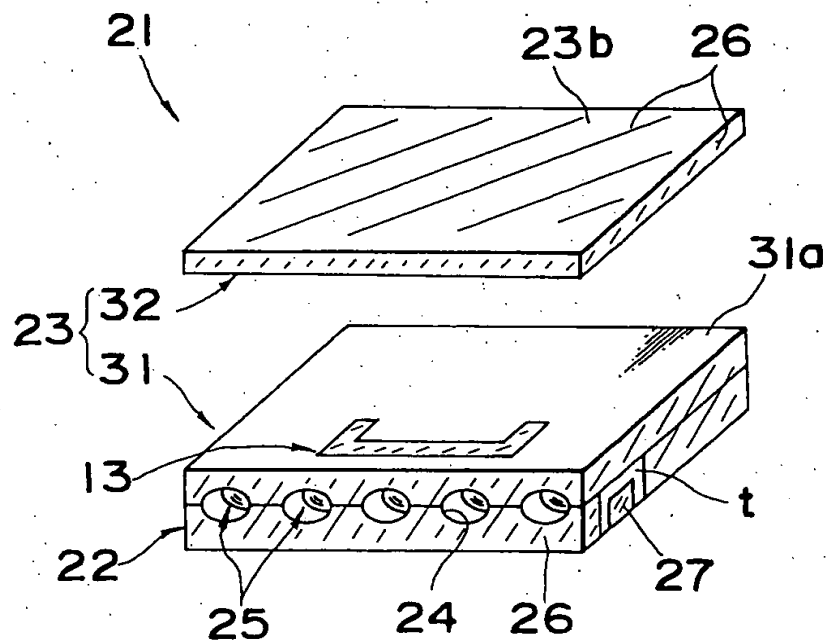


Fig. 36

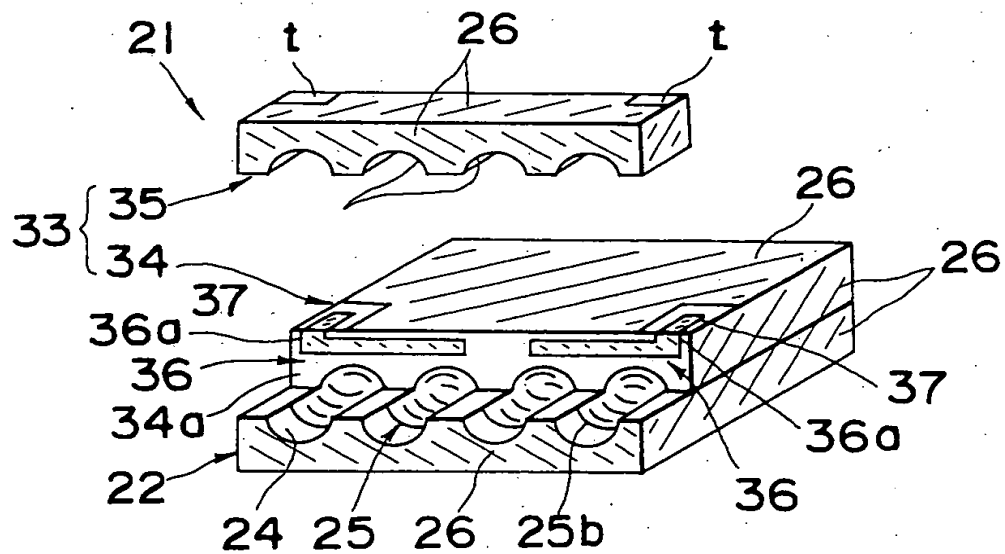


Fig. 37

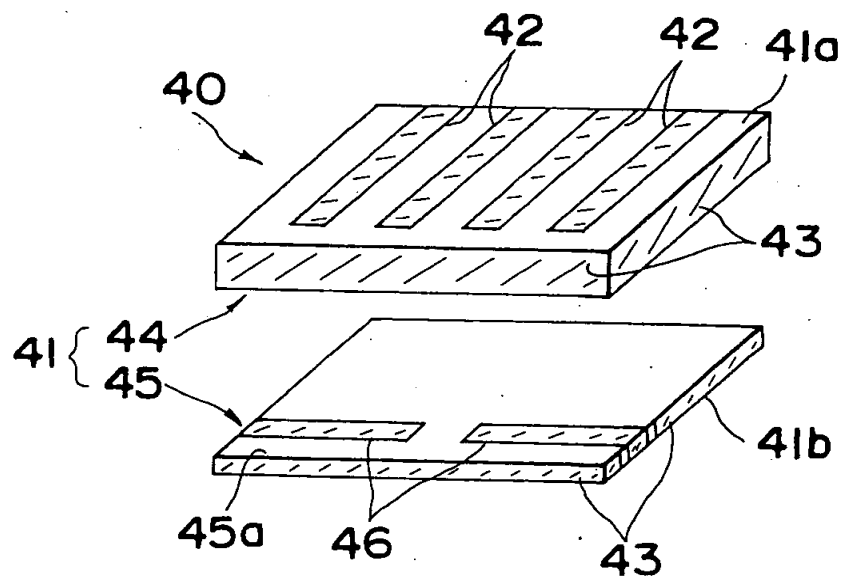


Fig. 38

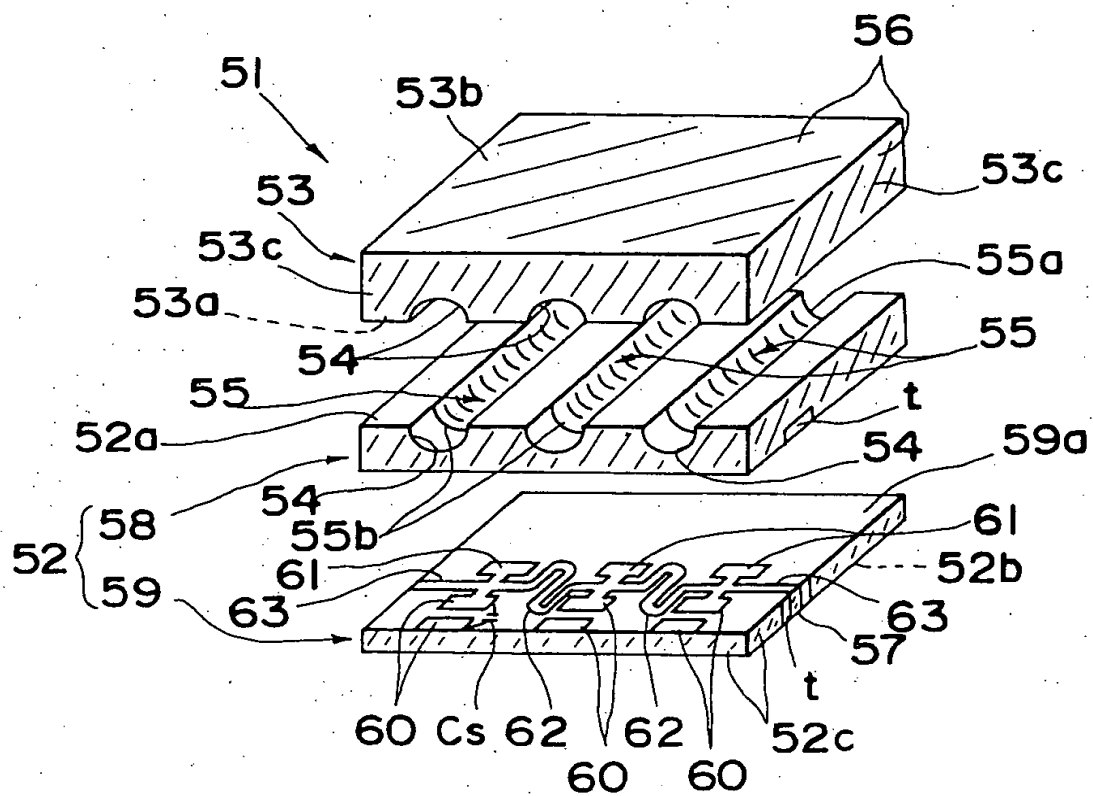


Fig. 39

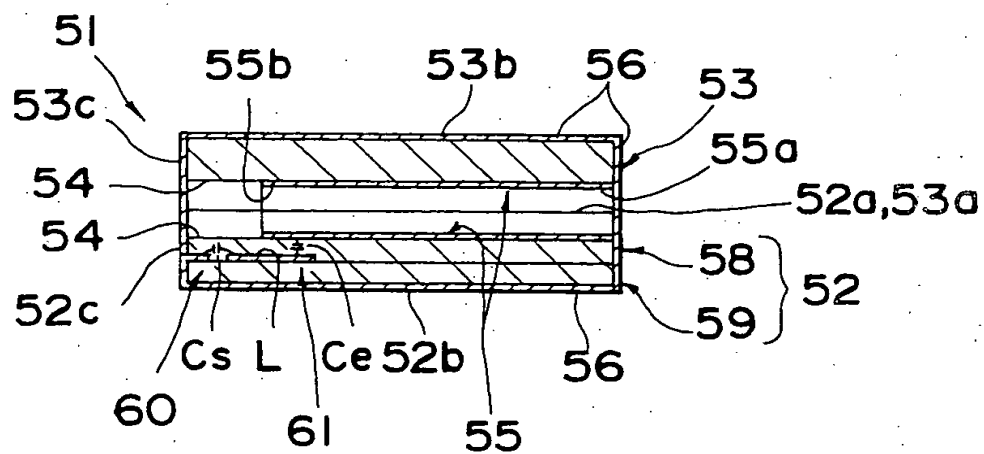


Fig. 40

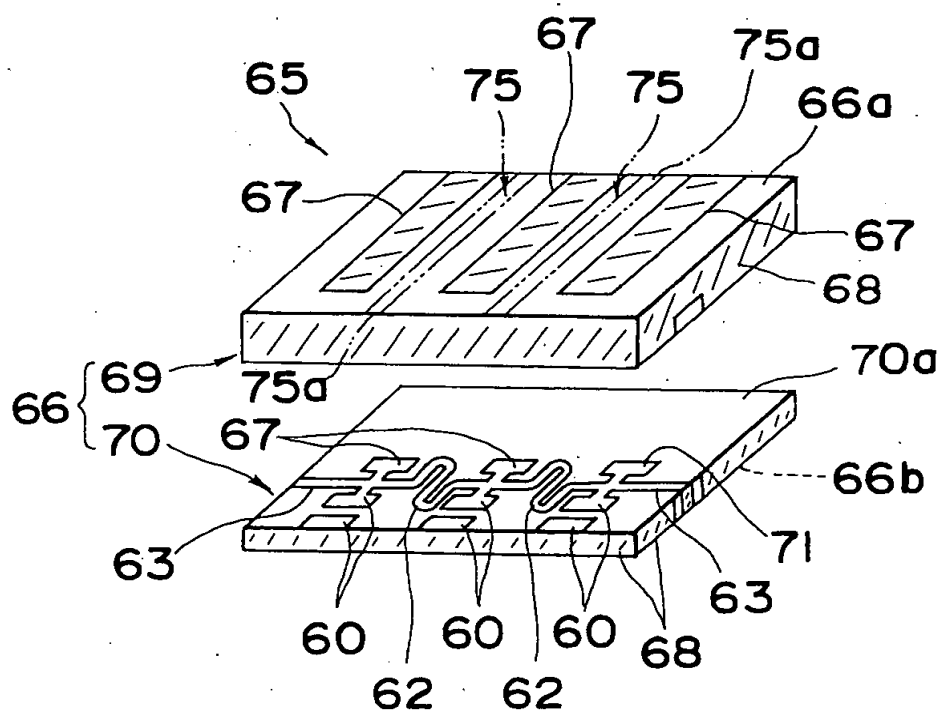


Fig. 41

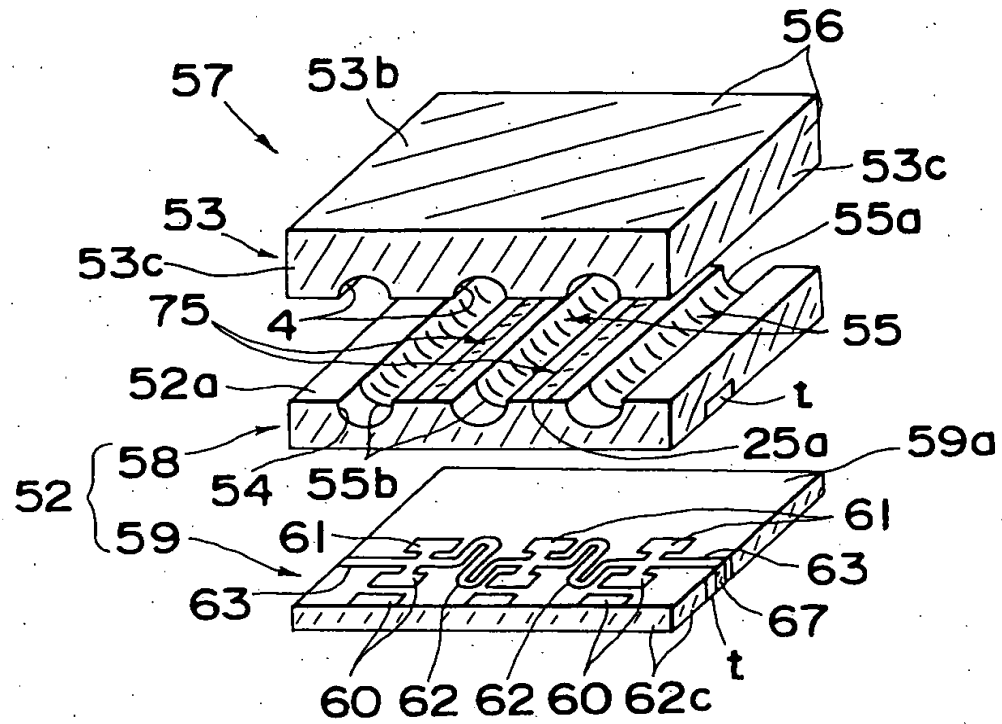


Fig. 42

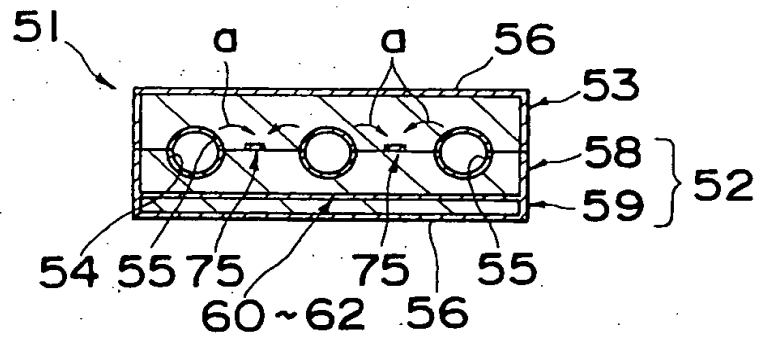


Fig. 43

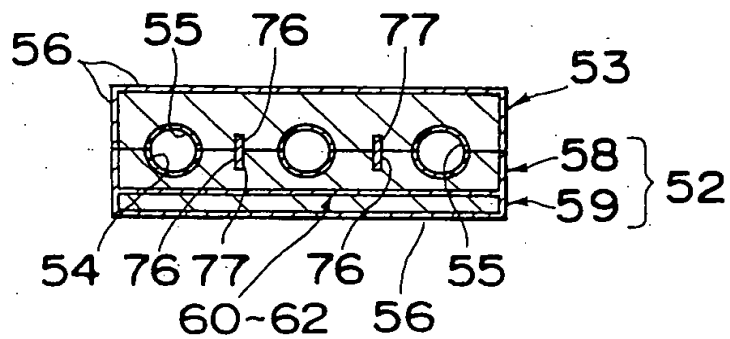


Fig. 44

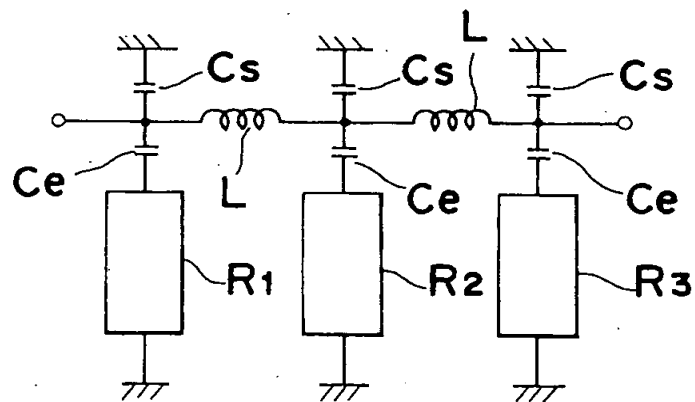


Fig. 45

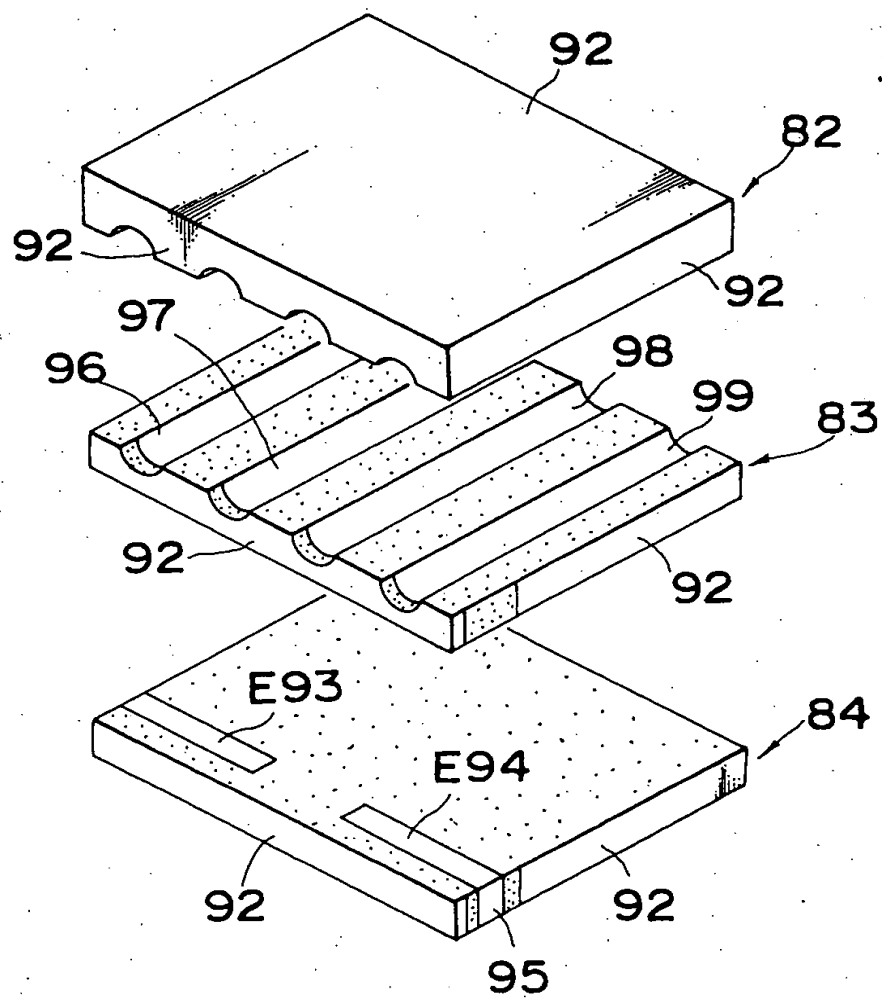


Fig. 46

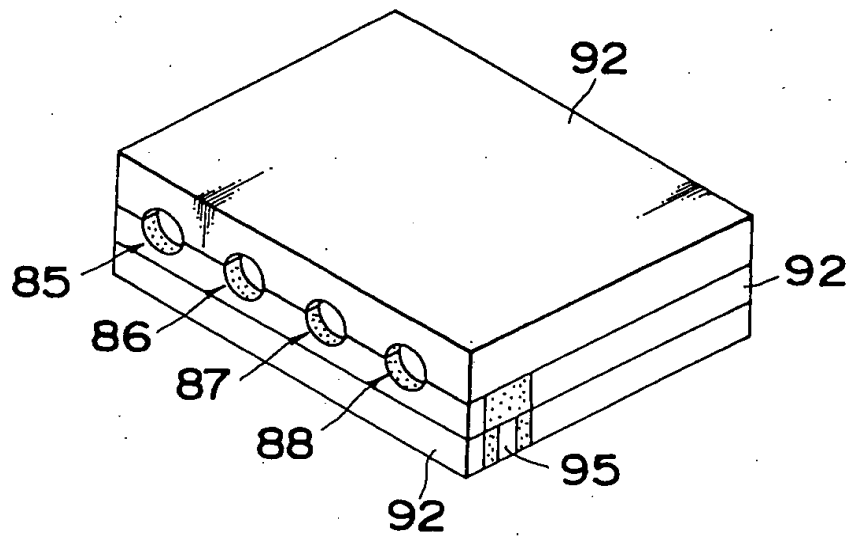


Fig. 47

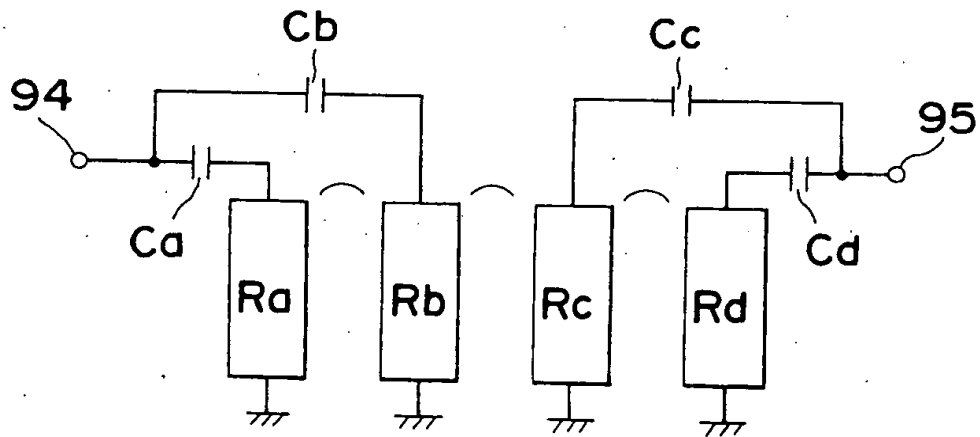


Fig. 48

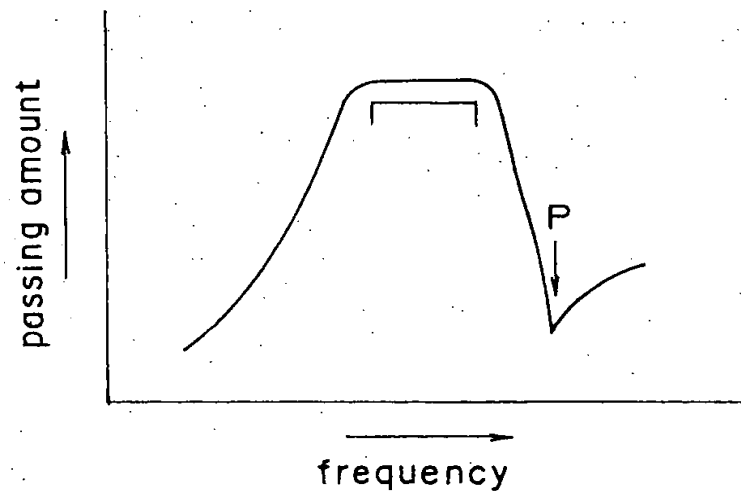


Fig. 49

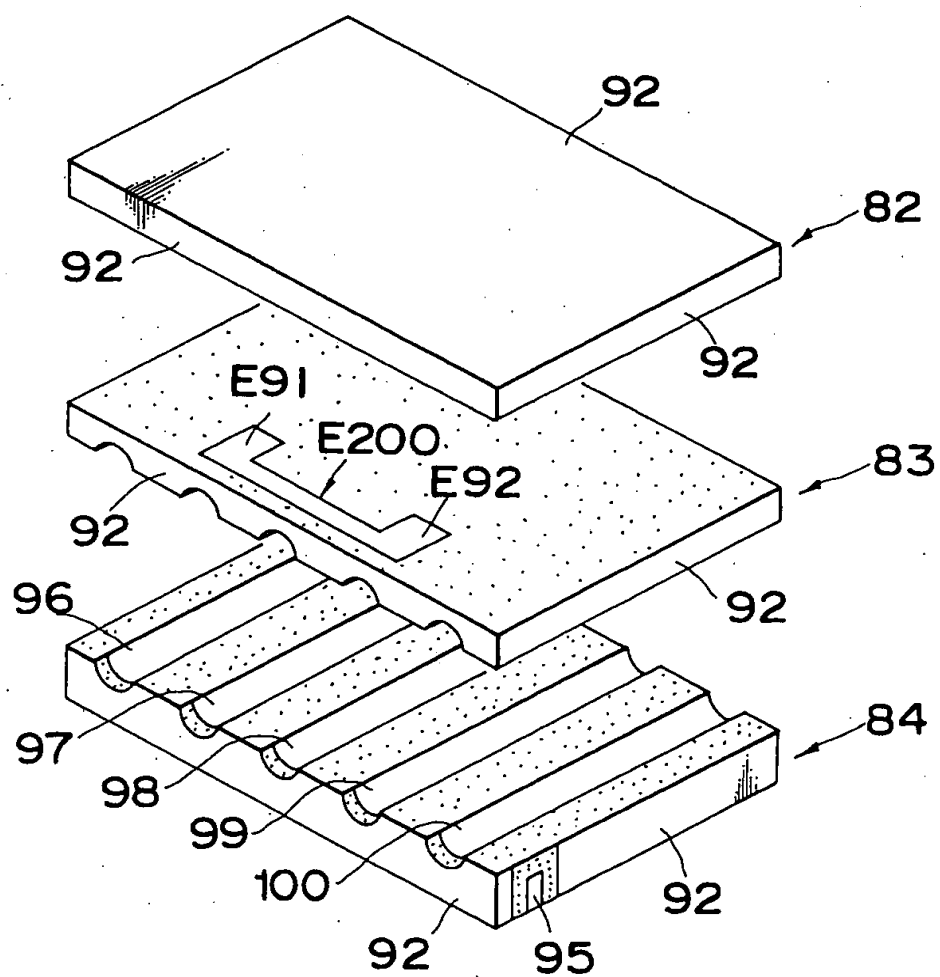


Fig. 50

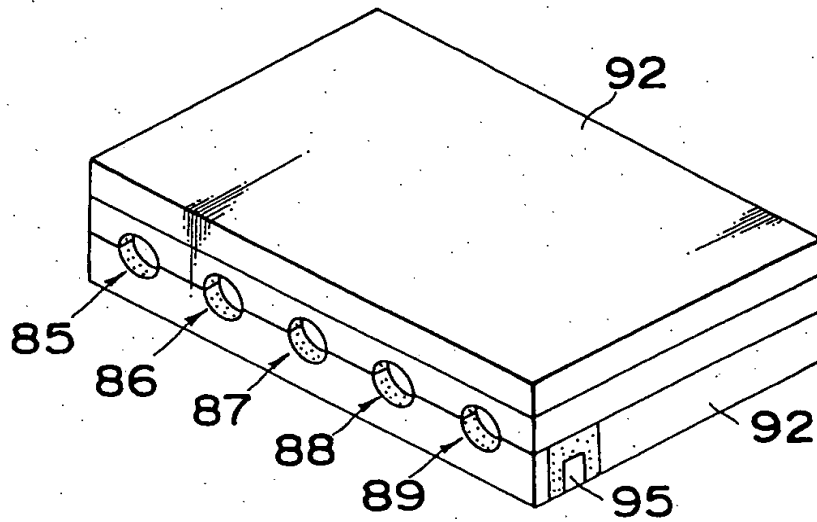


Fig. 51

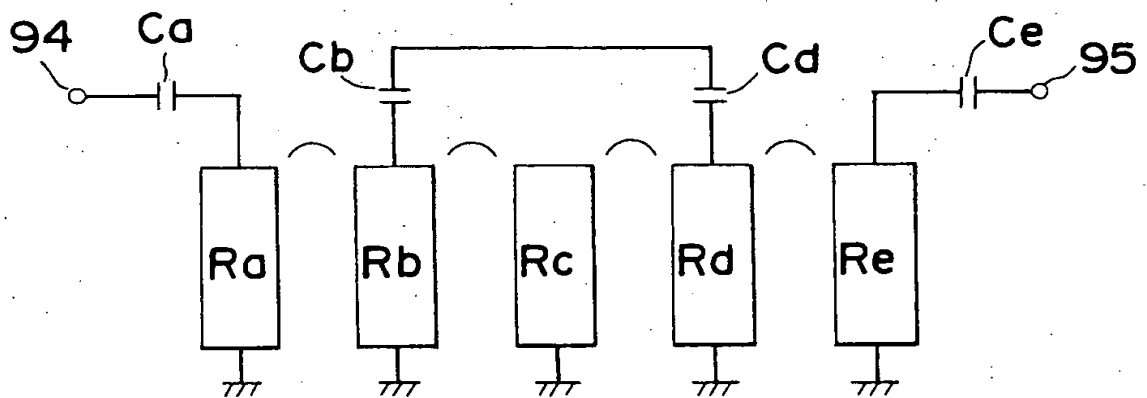


Fig. 52

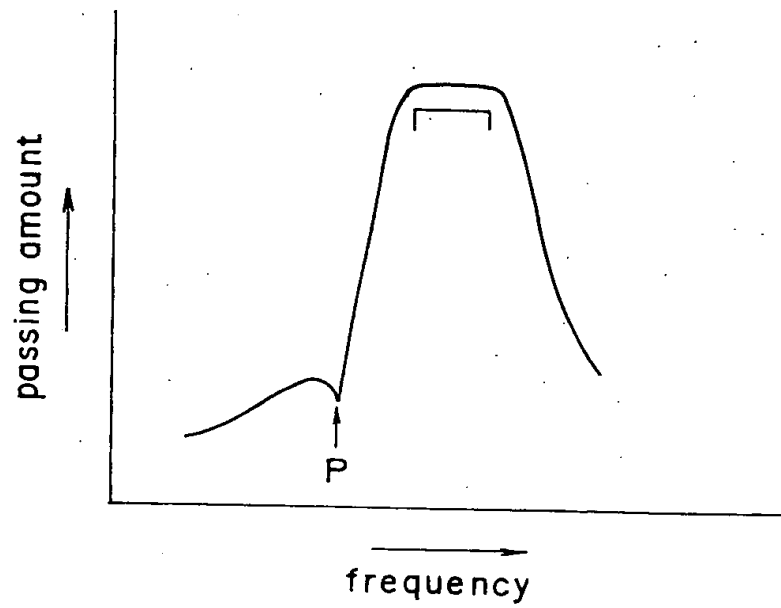


Fig. 53

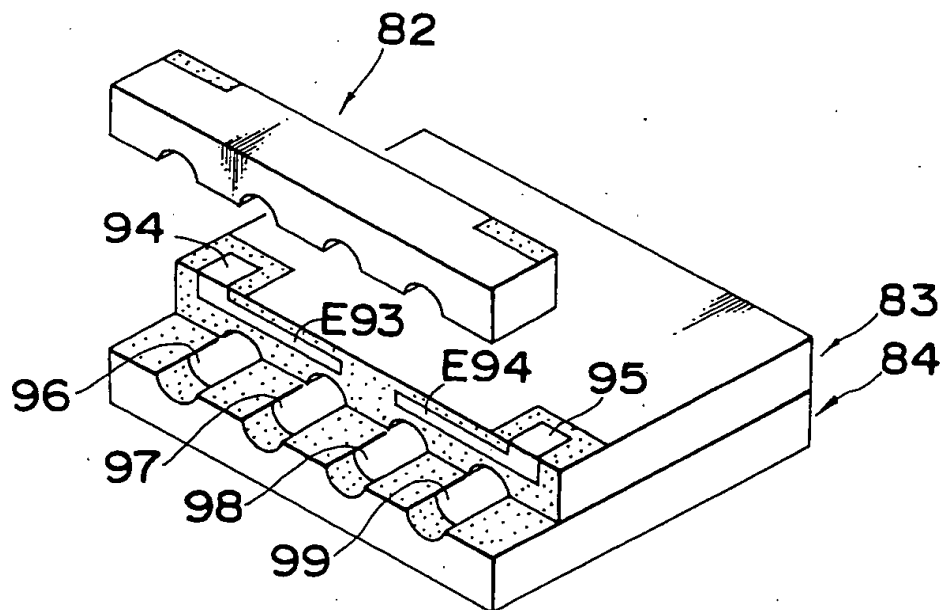


Fig. 54

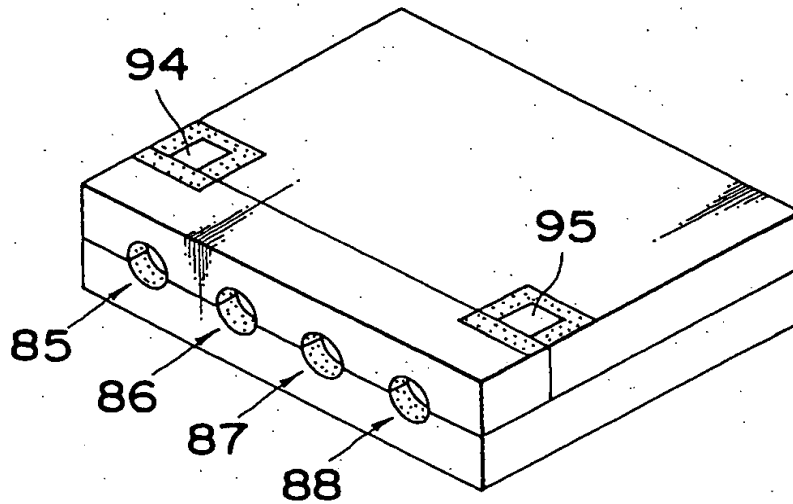


Fig. 55

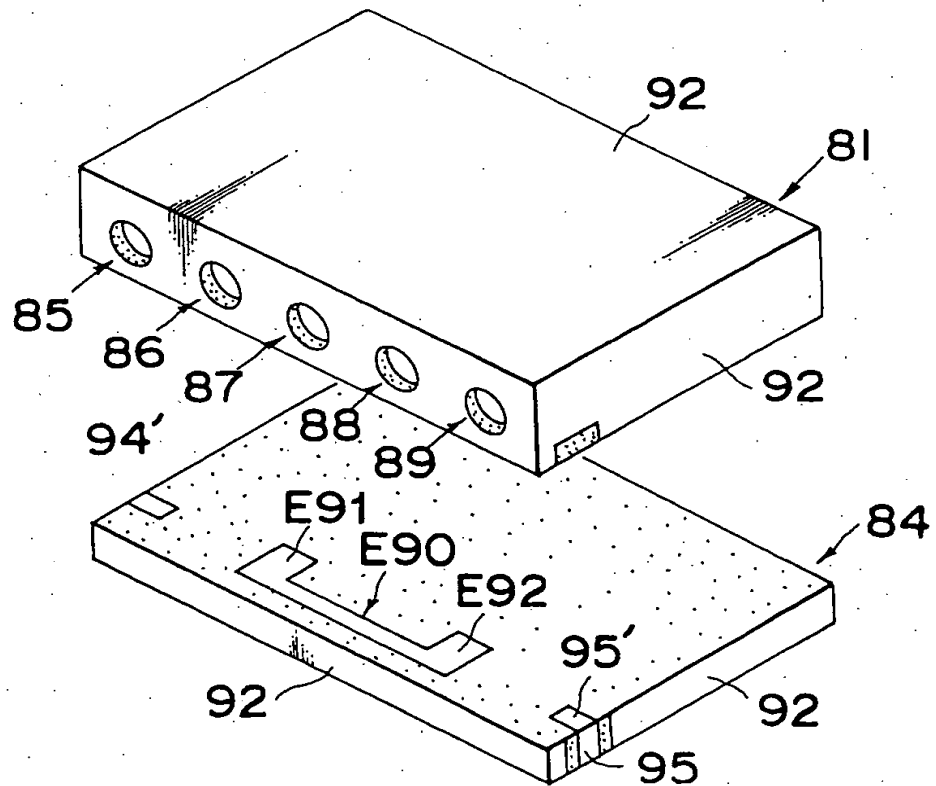


Fig. 56

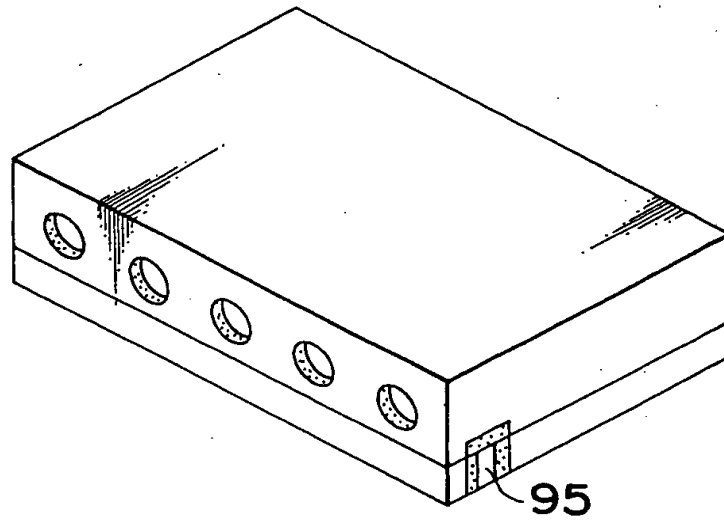


Fig. 57

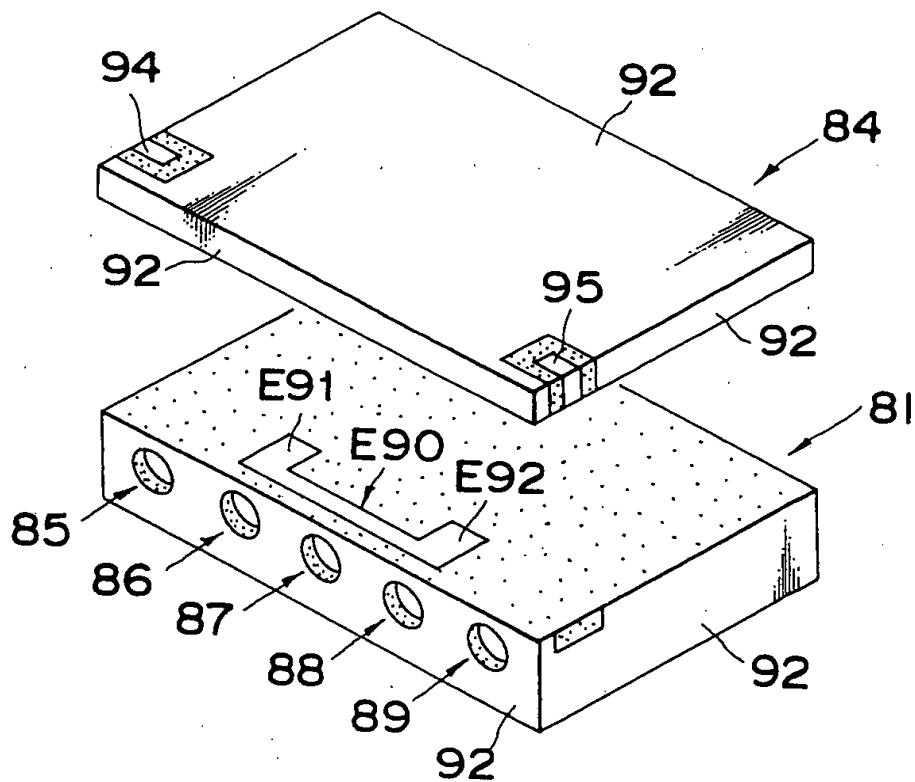


Fig. 58

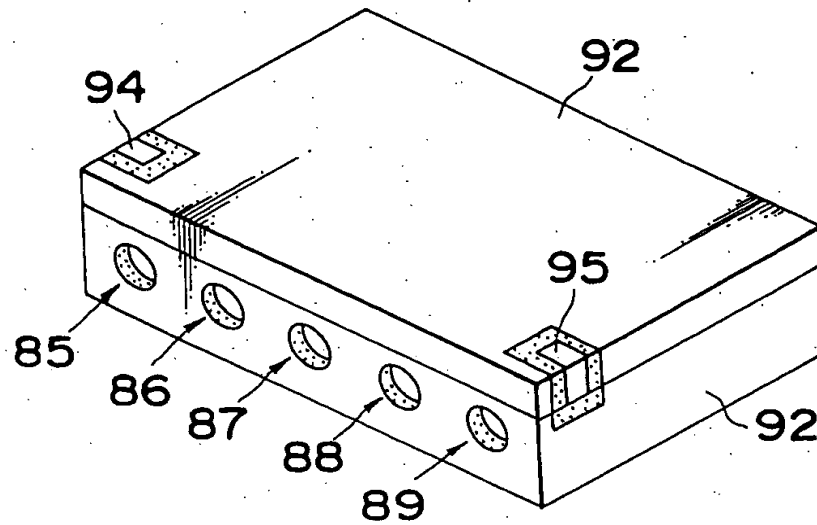


Fig. 59

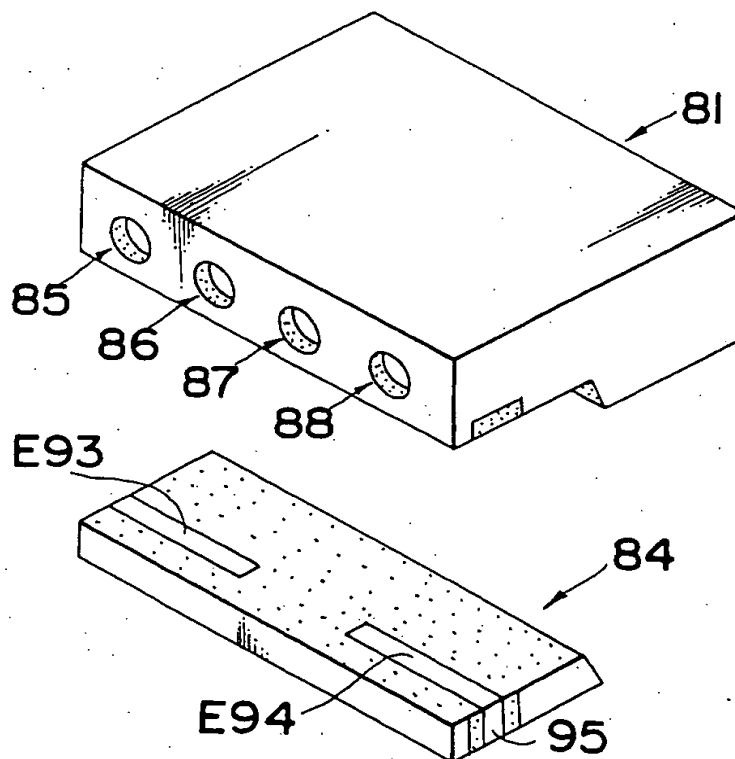


Fig. 60

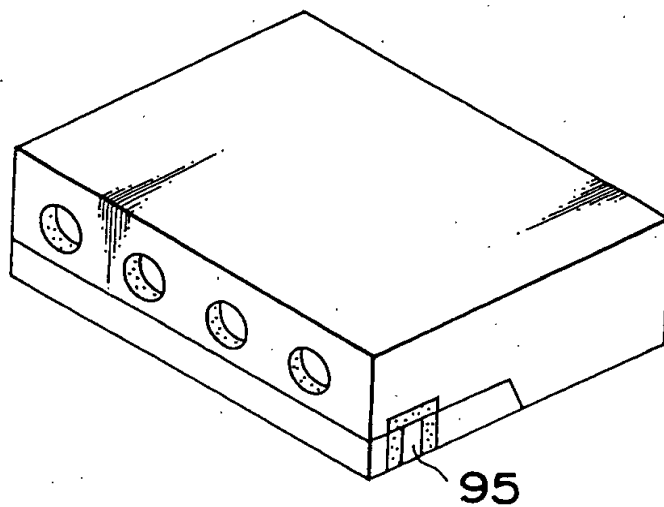


Fig. 61

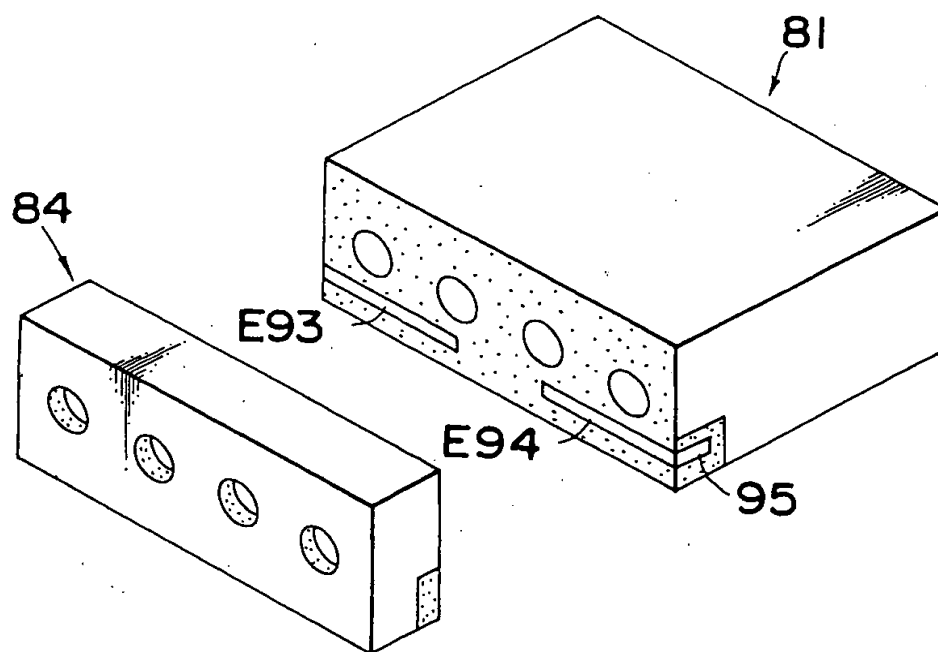


Fig. 62

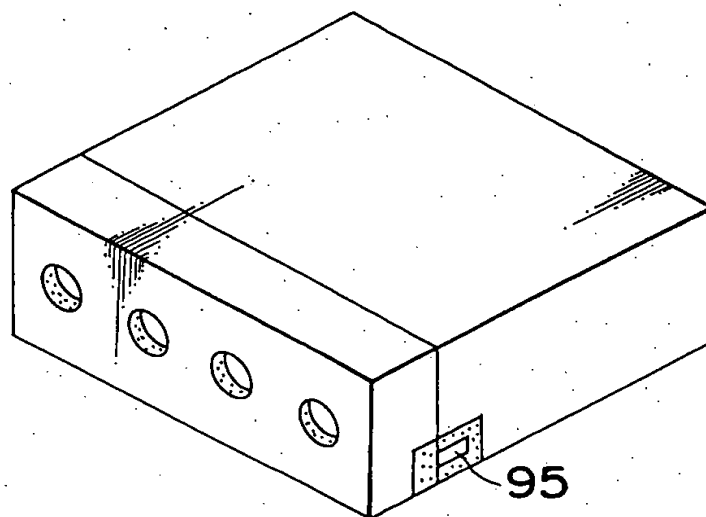


Fig. 63

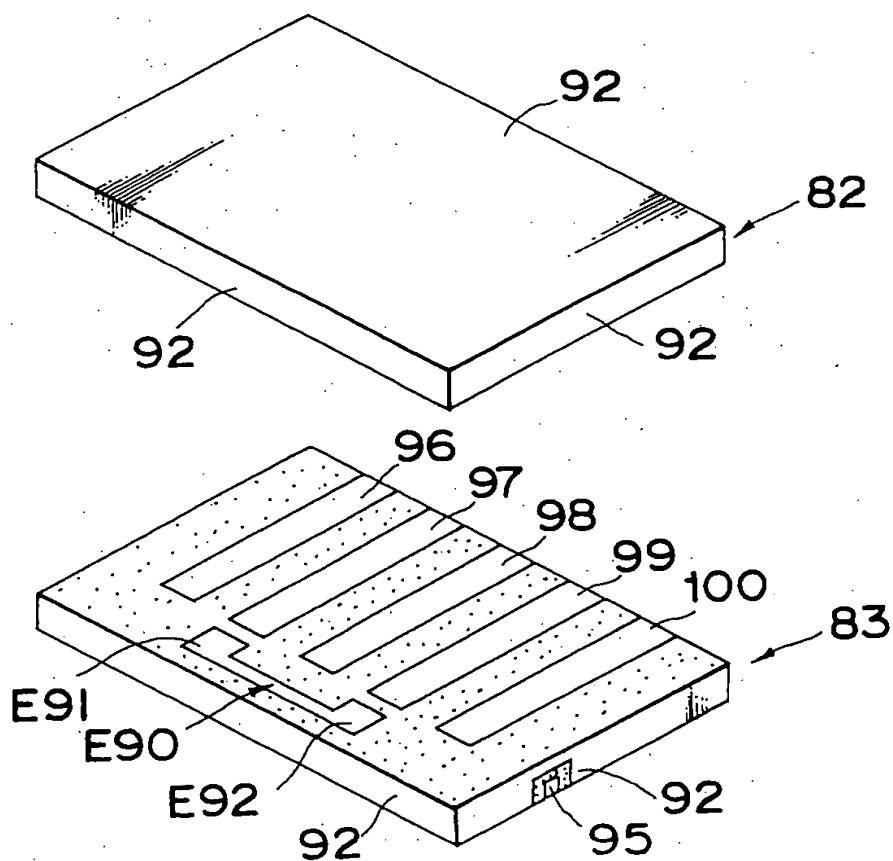


Fig. 64

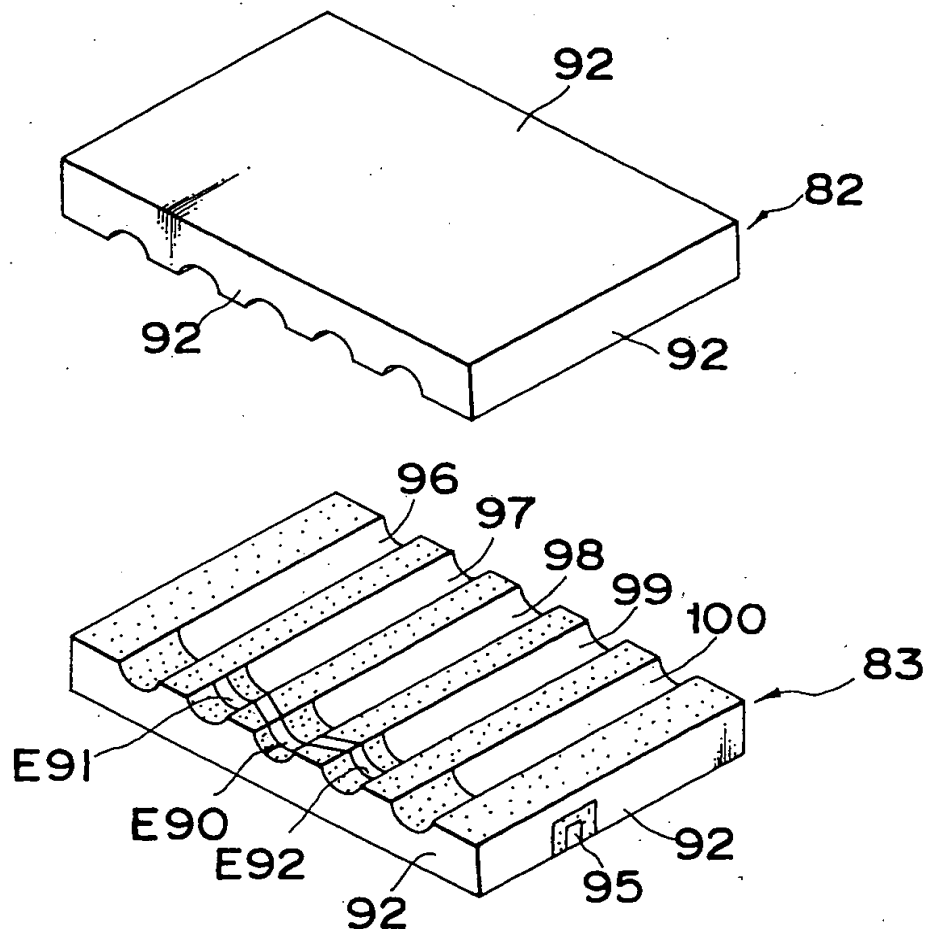


Fig. 65 PRIOR ART

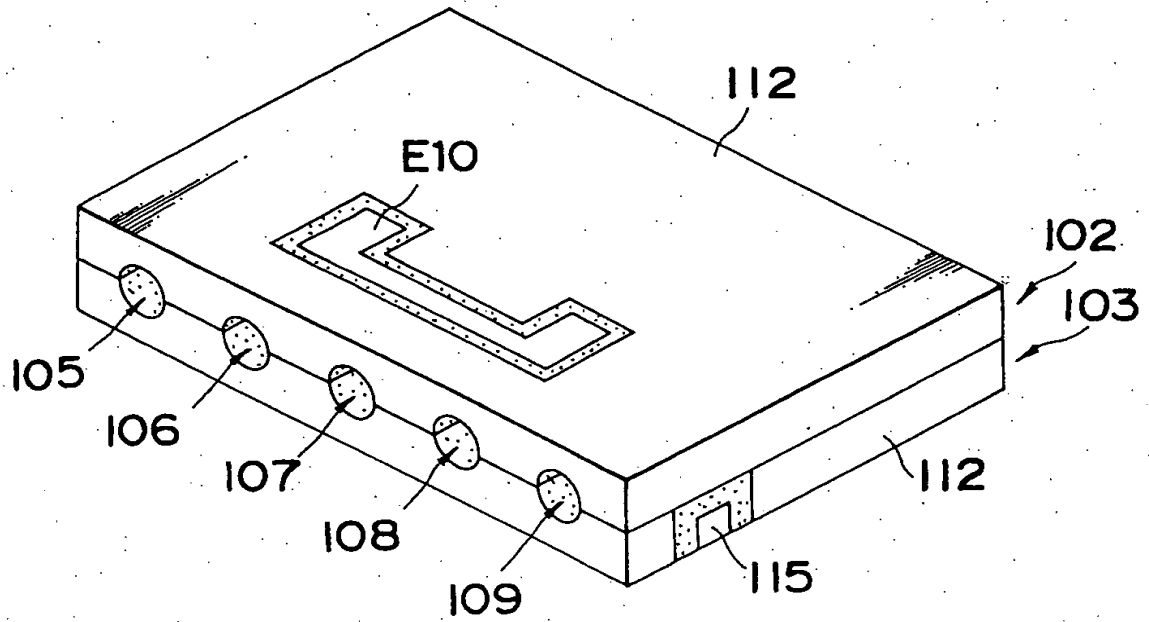
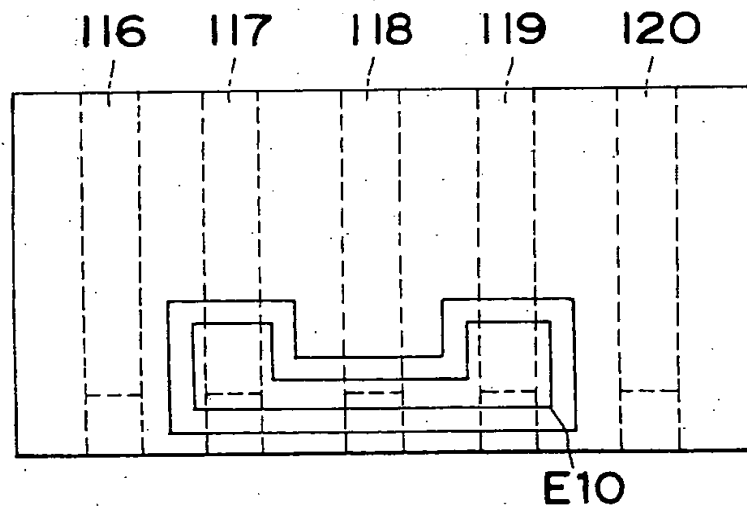


Fig. 66 PRIOR ART





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 10 0886

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 448 085 (SANYO ELECTRIC COMP LTD) * column 4, line 58 - column 5, line 34; figures 7,8 *	1-3,5-12	H01P1/205 H01P1/203
Y	---	4	
Y	EP-A-0 442 418 (OKI ELECTRIC IND CO LTD) * page 8, line 5 - line 12; figure 13 *	4	
X	EP-A-0 444 948 (FUJITSU LTD) * column 8, line 54 - column 9, line 16; figures 26,27 *	1-3,5-12	
X	PATENT ABSTRACTS OF JAPAN vol. 13, no. 292 (E-782)(3640) 6 July 1989 & JP-A-10 73 802 (MATSUSHITA ELECTRIC WORKS LTD) 20 March 1989 * abstract *	1,2	
A	EP-A-0 438 149 (FUJITSU LTD) * the whole document *	1-12	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H01P
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 APRIL 1993	Examiner DEN OTTER A.M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	